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THE ELECTRIFICATION OF A COMMONWEALTH.

By Sylvester Baxter.

Mr. Baxter presents what might be termed the amiable aspects of industrial centralization, from the viewpoint of appreciation and approval. The manifest fact is that economic forces are compelling a rapid movement toward centralization against which argument or legislation is of little effect. It is therefore an important service to set forth models of high standard—ideals of the best toward which the inevitable progress of the age may be directed. Such ideals and models are set forth in Mr. Baxter's concepts.—THE EDITORS.

POWER, a simple product, is put to complex uses. Industrial efficiency depends upon its well ordered production, distribution, consumption. The supplying of it may be regarded as a water-supply is. A city may best get its water from one common source. In the same way a community may best be supplied with power.

A highly significant example of how power for all industrial uses may be supplied from one central source, thereby affecting the economic organization of a whole State, is now presented in Connecticut. In no other State of the Union has the principle been so comprehensively applied—primarily to transportation; prospectively with regard to all demands for mechanical energy that may arise. The railway system—that is, the primary, or steam-line, service of the great transportation company that serves Connecticut in common with nearly all New England—stands at the threshold of electrification. Certain fortunate circumstances have prepared the way for the extension of its advantages in the efficient generation of motive power to collateral activities of various kinds. A striking sagacity and foresight in a survey of the economic horizon has been a guiding factor in establishing these singularly favorable conditions.

In the more populous sections a secondary system complementing the primary lines has been realized. Hence the same transportation company now owns the greater portion of the trolley lines, or street railways. These are never real competitors of the primary lines except in a minor and inconsiderable degree. Their function is essentially auxiliary. The street-railways are natural feeders of the primary lines. Two separate systems cannot well serve the same community without wasteful duplications.

Again, in the territory served by one general transportation system various other "natural monopolies" of a minor character, or rather of a more limited scope, also operate. Beside the local transportation services there are the water-supplies and the gas and electric plants for lighting, heat, and power. The great railway systems took shape by absorbing a multiplicity of short local lines for the organization of main routes of general traffic. In like manner all these local services tend to achieve a wider radius, extending their respective fields from within the bounds of single municipalities towards clusters of adjacent municipalities and even to groups of such clusters.

Street railways are no longer isolated local undertakings. One organization serves not only one urban cluster; through interurban lines its field comprises extensive groups of such clusters. In the same way all the municipalities in a given cluster are served in common by the same electric-lighting and power company, or gas company. Notable economies may be effected by associating many such companies under one central management. Supplies for the entire group may be purchased on a large scale and with corresponding economy. Better administrative and engineering talent may be obtained, with general officials and experts of the highest capacity in the service of all the companies, instead of separate sets of cheap and inferior men for each local concern. The course of "natural monopoly" is therefore towards the organization of larger units. These units tend to include not only all services of a similar nature, but all services that may depend upon a common form of energy or source of supply. Theoretically there appears to be no limit to this unifying tendency; in practice we see a steadily increasing realization of the principle.

In the specific instance here discussed the primary impulse in this momentous process was imparted by no deliberate initiative, no conscious planning of highly organized industrial activities from the ground up. It has been more like a natural evolution than a deliberately planned development. This seems the more remarkable in view of the circumstance that the process, as it advances, bears more and more the evidences of intelligent direction, of masterly leadership,

But it is the leadership that understands how to take a wise advantage of existing currents and tendencies of economics and industrial evolutions and shapes its course accordingly—much as the skilled aeronaut of today, by his knowledge of the directions of air currents in different latitudes and at different heights, might guide his balloon to some chosen destination beyond the Atlantic. The original impulse dates far back to the tendencies that grew out of the beginnings of the modern movements in transportation, manufacturing, and communication. All the concentration of mechanical energy and of capital, the combinations, the consolidations, the creation of larger units, the perfecting of organization on a colossal scale, thus became inevitable. The disposition to oppose, to obstruct, to prevent, these consummations is as futile as were the earlier struggles of handworkers against the introduction of the machinery that they feared was to deprive them of their livelihood.

In Connecticut the ground had been well prepared for the larger shaping of things. Sagacious minds perceived the possibilities resident in economic circumstance and proceeded to realize them. Back in the horse-car days it was not uncommon for a relatively small city to have two or more competitive street-railway companies. The consolidating tendency had at first a purely local scope. With electrification the connection of neighboring communities by interurban lines was a natural consequence, followed by consolidations of the local systems thus brought together. In Connecticut the organization of a general street-railway system for the entire State had thus been well advanced when the management of the great corporation that controls the primary railway service became alive to the desirability of a unified ownership of the primary and secondary lines. The consolidated trolley-lines were accordingly taken over.

It chanced that some of the local street-railway companies that had been acquired supplied the communities where they operated with electricity for light and power purposes. In certain instances the same companies also owned the local gas-works. Other local street-railway companies derived their electricity from water-powers of considerable magnitude, and some of these companies furnished the water-supply for the municipalities. Hence we see not only the transportation services of the State, both primary and secondary, controlled for the greater part by one corporation, but subsidiary thereto, to a considerable extent, the local supplies of light, heat, water and power.

We have seen that these functions were only incidental to the main business of transportation. It might perhaps be represented that there was no more reason why a great transportation undertaking should

administer these services than for it to enter upon any other commercial enterprise, such as selling groceries, for instance. Still, these extra functions are of the sort commonly recognized as public services. For good reasons they were performed by the local street-railway companies. For instance, since they had the capacity to generate more electricity than they required for their own uses they could profitably sell the surplus to the public. This enabled them to operate more economically and thereby serve the public with transportation to better advantage. Other companies whose electricity was generated from water-power found that with their surplus power they could economically pump water and supply it to cities and towns. Again, it has proved profitable in certain instances to supply gas in connection with the local transit service. Possibly the same gas may be economically utilized in internal-combustion engines for generating electric power. These functions had all been profitable to the local companies under the old conditions. In the economical disposition of surplus products or surplus energy they were legitimate adjuncts to their regular business. When the great transportation company acquired the street-railway properties these incidental functions continued profitable as before. But since the instances were few in number they formed inconsiderable items in the grand total of revenue-producing agencies. Had it been a question of organizing a comprehensive scheme anew, from the ground up, it might never have occurred to the management to assume the various subsidiary functions thus involved. But since the legislation whereby the street-railways were taken over had empowered the parent company to undertake generally all the activities previously exercised in special instances, it was led to consider the possibilities of a broad scheme of development that should include systematically organized operations of that sort.

In building up so complex a structure the material employed has naturally affected its shape very notably. In successive stages of acquisition smaller companies have been overlaid with greater ones until all have become elements in one great central corporation. In this way the ownership and operation of the street-railway properties now resides in a corporation known as the Connecticut Company. All the stock in this corporation is held by the parent railroad company, the New York, New Haven & Hartford. There is thus a distinction in function without a difference in actual proprietorship. For accounting and operating purposes the subsidiary corporation is a great administrative convenience. Street-railway practice differs in important respects from steam-railway practice. Even with the elec-

trification of the steam lines the difference must continue. The Connecticut Company has therefore a wholly distinct organization and a wholly different staff, responsible only to the executive of the parent company. While its operations are thus quite independent of the primary service they are co-ordinated wherever desirable. All this makes for the efficiency that experience shows is one of the results of modern operations on a large scale. It has been charged that vast corporate undertakings tend to become cumbersome and correspondingly inefficient. It is doubtful if any substantial basis for this assumption can be found when the unit principle of operation, as in the aforesaid instance, is adopted. Huge organizations like the Pennsylvania, the Southern Railway, and the Harriman systems attest the contrary.

This common ownership of primary and secondary railway systems makes possible a most admirable flexibility in operation. In nearly all the older parts of the country the haphazard building of unrelated pieces of independent lines in the same territory, eventually absorbed by a common interest, has led to the retention of much superfluous trackage. A most eminent authority has pointed out that were New England to be provided with an entirely new railway system a vastly superior service might be given with a reduction of the existing trackage by at least one-third. The waste from such unnecessary construction, perpetuated in operating and maintenance charges, is prodigious. It entails a corresponding burden upon the public.

In Connecticut the problem of utilizing some of this superfluous trackage has been solved by electrifying it and transferring it to the Connecticut Company for operation on trolley-line principles. At night the local freight service is performed by the steam-line organization. In developing a trolley service in the same territory as the steam line it is occasionally found desirable to build a new trolley line parallel with the steam tracks. The company apparently thus competes with itself. But the conditions of service and operation are so different that in reality the parallel trolley line is an auxiliary, a feeder, rather than a competitor in any true sense.

Again, unnecessary duplications are thus avoided. For example, the trolley-cars start from the railway station of a certain busy manufacturing city and enter upon an electrified old steam line that had been next to abandoned—previously operated only because the law required it—and at another city they again enter upon the streets and proceed to the business center. Here other trolley cars run to the station and enter upon other steam tracks, electrified for a couple of

miles, thereby saving that much parallel construction. Departing from the steam tracks, the trolley service runs over a new interurban line, substantially built according to steam-line principles. This line cuts across country by its own right of way, returning at intervals to the highways for the sake of passing through towns and villages. Entering the capital city of the State, the cars traverse the business center and cross the Connecticut over a noble commemorative bridge of granite, lately built. Here another interurban line continues the service; its trolley cars proceed to the station and there enter upon the steam-car tracks—this time those of one of the great double-track main lines of the system with an extensive traffic of its own in both passengers and freight. For some miles this main line has been electrified; the trolley cars stop only at the regular stations, but fares are charged according to the five-cent zone principle of electric-railway practice. At the first junction point the trolley cars pass from the main line onto an electrified branch of the steam system to an important mill-town; here they take to the streets and thence run across the hills by a long interurban line to an attractive country town of considerable importance.

The economy of this procedure is manifest. Common ownership of steam lines and trolleys has made it possible to utilize long stretches of the primary system also for the secondary service. Otherwise there would have been costly duplications, or, owing to the expense, there might have been attempted no secondary service at all. By thus averting outlays mounting into many hundreds of thousands, money has been saved for other improvements demanded by the public interest. In this connection it may be noted that an interurban line between Worcester in Massachusetts and Hartford in Connecticut had been planned. A portion of the trolley route above mentioned was to be utilized for the purpose. Massachusetts and Connecticut, in common with the other New England States, are served by the same great railway system. The general transportation conditions in the two States are as similar as in two adjacent counties served by the same railway. But the legal requirements so differ as to demand quite different methods in operation. The rigidity of Massachusetts law forbids ownership of trolley lines by a steam-railway company, unless by special dispensation. Hence there is a corresponding inflexibility of relationship between the primary and secondary systems. So long as this inhibition lasts, so long will it be impracticable to realize the much desired interurban route aforementioned. Trolley-line development has been correspondingly arrested in Massachusetts in recent years; lines that might be profitably undertaken by a great railway

corporation, with its command of large resources and its incentive to encourage local development in order to build up its territory and create new business for its primary service, are otherwise not attractive for capital.

The waste entailed by needless duplications in the way of parallel primary and secondary lines made necessary under Massachusetts restrictions is strikingly illustrated in the Greater Boston region. Trolley-line competition had made certain suburban branches of the steam lines unprofitable. The great company that controls the local-transit service has projected costly extensions of its rapid-transit system to the important suburbs, Malden and Medford. Under a common ownership of the primary and secondary systems the unprofitable branches to these suburbs might be used in connection with the latter service to mutual advantage, thus saving for other needed improvements the millions that otherwise will be called for by these extensions.

The foregoing glance at results in Connecticut indicates what may be expected in the way of public convenience and economy when manifold forms of service are permitted to draw their energy from a common source of supply. Years must go by before the ends aimed at in the Connecticut programme are fully realized. Yet when we recall what has been accomplished in the generation that has passed since electric lighting and power-development became commercially practicable, it is hardly too much to expect that before the next generation has half run its course the ends now planned for will be fully achieved.

Not so much for contrast as for comparison may a glance here be taken at conditions in a neighboring commonwealth that bear upon the same problems. The tendencies, the forces, at work to these ends are of course universal in their operation. Everywhere throughout our modern civilization they must in some way find expression. In Connecticut conditions are more prepared for such consummations than elsewhere in the United States. Massachusetts is one of the greatest of American industrial States. In its political, economic and social fabric it ranks as one of the most advanced and highly organized of communities. In its economic development and in its legislation, it has, as a whole, promoted the tendencies that in the policy of Connecticut have found so complete an expression.

For example, through nearly a half century it has been a settled policy in Massachusetts to encourage the consolidation of railway lines. The public authorities have gone so far as to urge consolidation upon unwilling corporations. Year after year the Board of Railroad Commissioners recommended that the two parallel lines, the

Boston & Maine and the Eastern, cease a destructive competition and come together. As a logical outcome of this policy nearly every steam-railway line in Massachusetts has come under a common ownership and management. There are only two important exceptions to this rule, and one is a branch of a great foreign system that incidentally crosses the State. Like tendencies have shaped the development of trolley lines. While street railways perform an essentially local service, there are now no strictly local street-railway systems in Massachusetts. The three or four great groups that divide the field seem destined to merge.

Yet in more recent Massachusetts legislation—perhaps in reflection of the curious illogical spirit that in federal legislation imposes condition which make competition impossible and in the next breath insists upon competition—there has been a disposition to surround each separate public-service function with strict lines of demarcation and confine its operations to its own particular bin, regardless of possibly very natural relations that might be established with its fellows and neighbors of other sorts. Hence under the law steam railways may have nothing to do with street railways, and neither steam railways nor street railways may acquire interest in the interurban lines termed "electric railroads" in local legislation parlance. All this rigidity in classification concerns three grades of railway practice that by nature have much in common. With the impending electrification of steam lines the convergence must increase. Yet for the time being there is a tendency to foster the very sort of competition among these differently classified varieties of transportation that public policy has discouraged when exerted within one class. All this makes impracticable the very desirable flexibility in operation that, as we have seen, is induced by the unification of primary and secondary services under a common control.

In other forms of public utilities the same rigid classification appears. Electric-light and power companies must keep apart from gas companies. An electric-light and power company may sell current for street-railway purposes, but no electric-railway company may sell its current for lighting and power purposes. Yet when artificial obstacles are interposed against the operation of world-wide economic tendencies that practically have the force of natural law, human ingenuity may be counted upon to find some way of overcoming them. In the case of gas and electric companies it takes the form of a trusteeship. The stock of numerous lighting companies is acquired, placed in the hands of trustees, and new stock is issued against their holdings. Marked economies and improvements are thus effected.

Another restrictive tendency in Massachusetts hampers the free operation of public-service corporations by laying down rules of conduct in internal administration that largely deprive them of the power of initiative desirable both in their own interest and that of the public. For instance, the great transportation company that serves nearly all New England, finding that its territory was threatened with a large and probably permanent increase in rates on anthracite, managed by an admirable stroke to secure control of one of the important anthracite railways. New England was thus securely protected against what would have severely taxed her domestic and industrial resources. But it was charged that this action, though so clearly in the interest of Massachusetts, was in violation of Massachusetts law; that while permitted by the company's Connecticut charter it was not permissible under its Massachusetts charter; that before securing control of the property in question the company should have come to the Massachusetts authorities for permission! Publicity, of course, not to mention the long delay, would have made the move impossible. Suppose a hunter, for each particular shot he desired to take, were required to go and obtain written permission from the game warden!

The various restrictions upon public-service undertakings imposed by Massachusetts law have thus tended more and more to obstruct the path of consistent development. In navigable waters we often see a series of stakes and beacons so set as to mark a safe channel across shallow places. But if these safeguards are set too close they may gather about them drifting sands and sediment, creating new shoals to imperil navigation. So, while aiming to prevent encroachments and interferences on the part of undertakings entrusted with the exercise of various public services, these restrictions tend to impede the efficiency of the services themselves.

The dread of monopoly and its possible abuses is natural. Unrestrained monopoly is something that may well be feared. But should we attempt to impede economic and industrial progress for fear that new conditions incidental to progress may make it possible for undesirable things to happen? Rather is it not the way of wisdom to prepare the freest possible road for the course of progress and at the same time, or as occasion may arise, to provide regulations that will direct in the right channels for the public good the unified and well co-ordinated activities that modern progress implies? Recent economic history indicates that there is little ground for the fear that monopolies may become so powerful as to direct the conduct of governments. On the contrary, the more effective the tendency to monopoly the more practicable becomes its regulation. Corruptive pres-

sure upon legislation was much greater in the days when hosts of minor competitive interests swarmed in legislative lobbies. To urge that public-service monopolies, although desirable for the sake of efficiency, should nevertheless be discouraged and forbidden, for the reason that they might exert so dangerous an influence upon government that it would be impossible to regulate them, implies a fundamental distrust of popular government. If a government cannot effectively regulate the conduct of a monopoly, is there any reason to expect that it can any better be trusted to regulate the more complicated conduct of manifold conflicting interests?

An efficient co-ordination of public-service functions should be the next great forward step in the economic world. Significant in this connection is the circumstance that the first decade of the twentieth century is marked by the development of the new technical calling, production engineering." Production engineers have worked wonders in promoting the efficiency of individual industries and of commercial or mercantile activities. The co-ordination of operations within a given enterprise, say a great factory or department store, is one of the chief factors in such work. It is particularly notable that production engineers have effected great economies in the workings of certain bureaus or department divisions in the national government at Washington. A sign of the times is the new appreciation of efficiency in connection with governmental operations—as witnessed by the favor with which the proposition for the appoinment of a permanent Director of Posts, or general manager of the postoffice department, with a possibility of saving many millions a year in the conduct of the service by the adoption of up-to-date business methods, is now looked upon among congressmen.

True economy will come with wise expenditure. Liberal expenditure, when well directed, begets liberal returns. Hence there is an immense field for production engineering in governmental service—national, state and municipal. And just as in the conduct of a city great efficiency can be achieved by thoroughly co-ordinating the operations of individual departments and introducing the spirit of team work among them, so not only in the public-service industries of city, State or nation are there immense possibilities in the ways that we have been considering, but ultimately in the establishment of economical and scientific interrelations among all the diverse factors of trade, communication, productive industry and finance. It is along such lines that the twentieth century seems destined to work out the great problems of efficiency and conservation that, broadly considered, comprise the most vital elements of human wellbeing and progress.

THE ECONOMICS OF FACTORY VENTILATION.

By Royce W. Gilbert.

Ventilation has been actively discussed as a mechanical function. Its foundational data have been defined and its apparatus reviewed very thoroughly, this aspect of the problem having been clearly surveyed by Mr. P. R. Moses in these pages only three months ago.

Mr. Gilbert presents the matter in a new light—that of efficiency. His argument is the increased output—the decreased cost of production—that results from the higher efficiency of workers when proper ventilation is provided. The proposition is advanced here broadly, or with only general quantitative data, with the hope of returning to the subject later in a more conclusive and technical study.—THE EDITORS.

WEBSTER'S definition of the word ventilation is "to air" or "to replace foul air by fresh." In actual practice, however, ventilation should mean more than this. It should mean the conditioning of the air of any enclosed space to the best requirements, of the occupants of that space. In fulfilling these requirements, the practice should embrace the heating of air in winter, the cooling of air in summer, the moistening of too dry air, and the drying of too moist air, the exclusion of dust, odors, fumes, gases, and microscopic life.

As people and machines tend to produce certain injurious elements, provision must be made to carry away the waste as rapidly as it is produced. People, in common with all warm-blooded animals, require a certain amount of oxygen in the air they breathe. To fulfill these two requirements the engineer has adapted the method of change of air as the simplest. To say that this is the cheapest and final method is to jump at an unproved conclusion. So important has this change of air become, however, in the minds of many engineers that it has usurped the place of ventilation in the broader sense, and in the ordinary engineer's vocabulary the term is adopted in this exclusive sense. This misguiding of thought and effort into a rut, as well as the lack of realization of the modern effective incentive—economy—has delayed the progress of this branch of sanitation and kept it behind that of water supply and sewage disposal.

There are three incentives to the progress of ventilation today, which I will consider briefly in turn. First is that of better health

for the people (who will not pay for it). This incentive depends for its strength chiefly on the latent sense of social obligation in the man or men who furnish the capital for a public building or work place. The air of our churches, street, and railway cars, shows plainly the ineffectiveness of this incentive.

The second incentive is that of comfort (which the people are ready to pay for). This incentive is especially strong in America, where people pay more and are ready to pay more for comfort than the people of any other land. That the average American fully believes and practices the philosophy of "a short life but a merry one" is more than self-evident—it fairly obtrudes itself. The adoption of this theory is, however, not the intelligent adoption of a life philosophy, but merely the unthinking and most natural trend of a great population in a new country, with an unstable social scale and a general advancement in social rank.

To this general advancement and its necessarily insatiate demand for great profits, we owe the past decades of unthinking exploitation, of wasteful processes and uneconomic manufacturing. Now that we as a people have been suddenly jolted into a realization of our crude and expensive system of economics, and to the need for conservation, the persistent demand for an increasing income has led us to an almost abrupt about-face in our economics of production. Today the thoughtful manufacturer or the wise capitalist knows that economy in production may mean bigger dividends than increase of capacity. In the modern factory, money saved is indeed money earned, and the chances of earning money in this way in our industrial life today are just as numerous as were ever the chances in increased production and market creation of the past fifty years. An increased output usually has to await an increased market. Decreased cost of production means immediate profit.

To this realization of a potential source of income, and to the fact that labor is the most expensive item in the machine of modern production, we owe the third incentive to good ventilation—namely, increased efficiency of labor, which means actual saving of money and therefore increased dividends. I believe the time is not far off when our mills and factories will be the most perfectly ventilated buildings that we will have. The American producer is too desirous of the above mentioned increase in dividends to neglect for long a business opportunity with such sure and bounteous returns as increased efficiency of labor offers.

This consideration leads us back to the first incentive, health. In this the mass of the people and eventually the State will recognize

the present overwhelming loss of life and efficiency, and we will all be required to live strictly healthful lives, in accordance with the sanitary rules of most progressive science. When that time comes, health will be the great incentive to ventilation as to all other sanitary work. The thousand must see clearly, however, before the million—hence our greatest present incentive—economy of production.

It is needless to speak of the present ordinary efficiency of indoor workers. Every foreman, every superintendent, even the workers themselves know how low it is. They know the "eleven o'clock fag" and the listless waiting for the five o'clock whistle. The money loss of this low efficiency is too obvious to need any amount of elaboration. Savings are usually recorded in percentage of cost of the total item. If 10 per cent is saved in a year in any important item of production cost, the superintendent is certainly to be congratulated. If the 50 per cent efficiency of the average factory worker can be raised to 75 per cent at a cost of 5 per cent of the total payroll (for interest on the cost of a ventilating system, replacement fund, and operation) is the question not worth serious attention?

Suppose a shoe factory to employ two hundred operatives. The yearly payroll will be about $75,000. A 25 per cent increase in efficiency would mean $18,750 worth more work. Five per cent of $75,000 ($3,750), would pay 5 per cent interest, 5 per cent replacement, and 5 per cent operation charges on a $25,000 ventilating plant. Such a system would in general be sufficient for a two-hundred operative factory. The net annual profit would be $15,000.

Some processes require fresh air, and in these the efficiency of the workers should be high though not necessarily as high as proper ventilation can raise it, for the simple reason that "fresh" air is not always the same and at times it may not be best suited to the needs of the workers.

In other industrial plants, such as cotton mills, a warm, humid, air must be employed in order to protect the quality of the product. In such plants, the labor efficiency will be low and allowance must be made for the fact.

Some factories say that piece work eliminates the efficiency factor altogether. If machines are used, however, it is readily seen that as the value of a machine depends upon its output, it is much cheaper to provide the simple machinery usually adequate for ventilating purposes, than it is to provide 10 to 25 per cent more of the complicated machinery of most factory work.

No matter what the nature of the work, mental, physical, or merely mechanical, if the air the worker breathes and is surrounded

by is not suited to his body or his task, an improvement in that air is bound to make for increased efficiency. Ventilation alone may not bring the average 50 per cent worker up to his full efficiency, but it should account for 25 per cent. The other 25 per cent may most likely be lost in unsuitable home environment, and however desirable improvement in the home environment of the worker may be, the shifting condition of labor in most localities makes any improvement approaching the ideal, by factory or mill owner, a very doubtful investment from the standpoint of cold cash.

Many superintendents and owners are still in doubt as to the advisability of investment in ventilating equipment which they fear will not prove satisfactory. They may be influenced by personal experience with ventilating systems that have failed to ventilate, or they may on general principles consider ventilating engineers as very superfluous persons indeed. Some are. Modern engineers however who approach the subject from the sanitary side, and consider the effect on the occupants of a room as well as the purely mechanical problem of moving a certain quantity of air into the room, prove themselves very valuable additions to the consulting staff of any industrial establishment.

I will not trench on Mr. Moses' able articles which recently appeared in this publication, as far as the mechanical methods of securing results are concerned, for I consider that he covered the field in an exceptionally comprehensive manner. I would like to mention however some of the elements to be considered when formulating desired results.

The movement of air may be regarded in general entirely from the standpoint of removal of waste. If all wastes of people or processes are removed by air carriage as soon as produced, no care need be taken for the sufficient supply of oxygen. If however no dusts or fumes are produced, the moisture is absorbed or precipitated, the heat is absorbed, and the odors oxidised (most common odors are oxidised by ozone), then a movement of air into the room may still be necessary in order to supply the requisite amount of oxygen. The presence of carbon dioxide alone even to the extent of 25 to 30 parts will not be injurious or noticeable. The gas itself has no noticeable effect, with low temperature and humidity, till it is present in much larger quantities than ever occur even in rooms with no devised system of change of air. The constant passage of air as well as the natural diffusion of the gas, through walls, around windows, etc., keeps the carbon dioxide content to below 50 parts per 10,000. Of course in actual practice 10 to 15 parts per 10,000

is the allowable limit, on the supposition that the gas is an index to other vitiating elements.

High humidity and temperature (causing interference with the natural dissipation of body heat), unpleasant odors, fumes, dust, and bacteria or moulds, are the causes of low efficiency. Microscopic organisms are always dangerous. Wherever dust is present, to act as carriers for the germs, there is always danger from colds and minor affections that often cause loss of time or decreased efficiency, and very often there is danger from specific lung and throat diseases. The practical elimination of dust would practically dispel the danger from germs. If dust cannot be entirely eliminated it can at least be minimized in quantity, in any process. Dust in itself appears to be merely irritating, but irritation of the eyes, throat, mucous membrane, and lungs, causes a lowering of resistance to pathogenic germs. This lowering of resistance means simply a lowering of body efficiency which of course means working efficiency.

Odors, gases, and fumes, are to be distinguished from one another. Fumes are the visible air-carried products of certain chemical reactions, and are nearly always directly injurious to health. Gases may be directly injurious or merely irritating. Odors are seldom directly injurious, merely unpleasant and irritating; minor contributors to inefficiency. The foregoing are all elements to be avoided. The *ideal* to be worked for should always be their complete absence in the air of any working place.

Temperature and humidity are not impurities. The *presence* of each is essential; their *limits* however must be carefully regulated. It is here that the study of individual factory conditions is most necessary to satisfactory air supply. Disregarding those industries where the air must be conditioned to suit the article of manufacture, the temperature and humidity must be regulated, in accordance with the requirements of each special class of worker, and each special class of work. There is reason to believe that laborers coming from Southern Europe, accustomed to warm, humid climates, are less affected by such conditions as are imposed by the great cotton mills of Massachusetts than are those from Northern Europe, accustomed to cooler, dryer air. Male workers sometimes require a different quality of air from that suited to female workers. Nature of operation makes a great difference in the optimum quality of the air. Not only the operations requiring a considerable amount of physical exercise, but even those in which the operator stands, require for the best results a slightly lower temperature and humidity than do those in which the operator sits.

Clerks or bookkeepers apparently require slightly more rapid heat removal than do persons engaged in work consisting of purely mechanical movement, with little brain effort.

To attain the desired results after they have been formulated, the nature of the walls, floors, machinery, and article of manufacture must be considered as to their effect on the amount of moisture in the air. They may be absorbent, or condensing, or practically neutral. Their absorption and retention of heat must also be considered. The shape of the space under consideration, baffles, or obstacles to air movement, such as machines, furniture, etc., must be taken into account. Air should never be allowed to stagnate as stagnant air apparently never has the feeling of freshness of air in motion, and hence is not so suitable for workers.

In most instances a relative humidity of 60 to 70 per cent and a temperature of 65 to 70 degrees represent the conditions favorable to the highest efficiency. Where it is not possible to reach this limit other conditions must be made to comply with requirements for *comfort* of the workers, for after all, *comfort* is the best index to efficiency-producing conditions.

All these elements entering into the problem of ventilating for efficiency make the subject one in which careful thought and study covering each individual factory or work place is essential. The original plans should show the results of this study. The ventilating engineer's work, however, is not as a rule completed upon the completion of the plans or even of the plant. To give satisfaction the plant *must* be inspected at frequent intervals. When alterations are made in the use of a room, when the number of regular occupants is increased, or when the amount or kind of machinery is changed, the engineer *must* be consulted if the ventilation is to remain as he designed it.

Neglect is the most frequent cause of the failure of ventilating plants to ventilate. The fans may run and not furnish the desired quantity of air, the desired quantity may circulate but not be kept at the desired quality. A very common example of neglect is the overheating of rooms and the heating of rooms when they are not in use. I have found buildings where the temperature as shown by recording thermometers went as high as 90 degrees during the night. Such cases as this are not infrequent and are a pure waste of fuel even when the overheating does not come in working hours and cause a loss of efficiency in addition. In one building, recently, I found that the engineer was in the habit of leaving open a door between the boiler room and the fan room. He was also in the habit of blowing his valves in the boiler room, with the result that

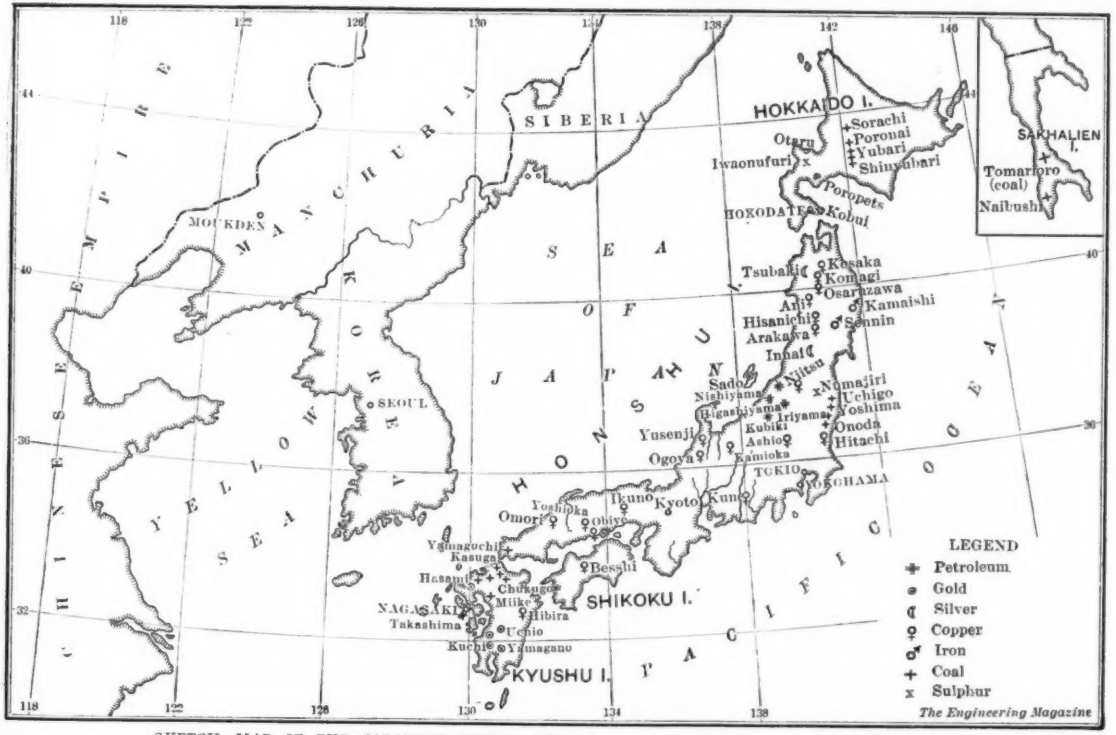
nearly saturated air was often supplied to the building, often causing great discomfort to the occupants. The average engineer of a building *will not* pay to the ventilating plant the attention he pays to his engines and other machinery. He regards it as more or less of a useless or perhaps an automatic device. Even though it were possible to build a truly automatic system, it would not be possible to build one that would run year in and year out with the slight attention usually bestowed on such a system. Neither could it be built absolutely fool-proof.

The superintendent or manager cannot always give the matter his personal attention, and as a result a properly designed and installed system may be classed as a failure, a few years—or a few months even, in some cases—after its installation. I have known of instances where the plant was *never* run as designed, from the beginning, on account of some prejudice of the operating engineer.

The only insurance adequate to the situation and satisfying to the superintendent and to the designer which I have found is the use of recording thermometers and hygrometers, located at strategic points of the ventilating system. These instruments, provided with weekly charts, show plainly the daily and hourly condition of the air with respect to what are perhaps the two most important considerations of the effect on labor efficiency. The charts should be filed with the manager or superintendent and so form an accurate index to the quality of air supplied at all times of the year. They enable the designer to keep in touch with the working of his system and enable him to locate trouble readily. To the superintendent the charts are the means of checking up his engine-room force, as well as his means of knowing whether or not his owners got what they paid for in their ventilating system.

The whole question of industrial ventilation is intricate and worthy of the very serious and careful consideration of experts. That consideration being given, however, the resultant effect of the quality of air supplied by the evolved system is *bound* to mean *money—lessening of expense of production, bigger dividends*—to say nothing of more contented labor, which today is a factor of no mean importance in any industrial centre.

There is no compelling force in our modern life so strong as money, the increase in philanthropy and humanitarianism notwithstanding. Once it is clearly understood that well ventilated work places mean *money,* and ill ventilated work places mean *loss of money,* to the owners—then, and not till then, may we be sure that the day of sweat shop and stuffy factory is over, once and for all.



SKETCH MAP OF THE JAPANESE EMPIRE SHOWING THE PRINCIPAL MINERAL DEPOSITS.

MINERAL RESOURCES OF THE JAPANESE EMPIRE.

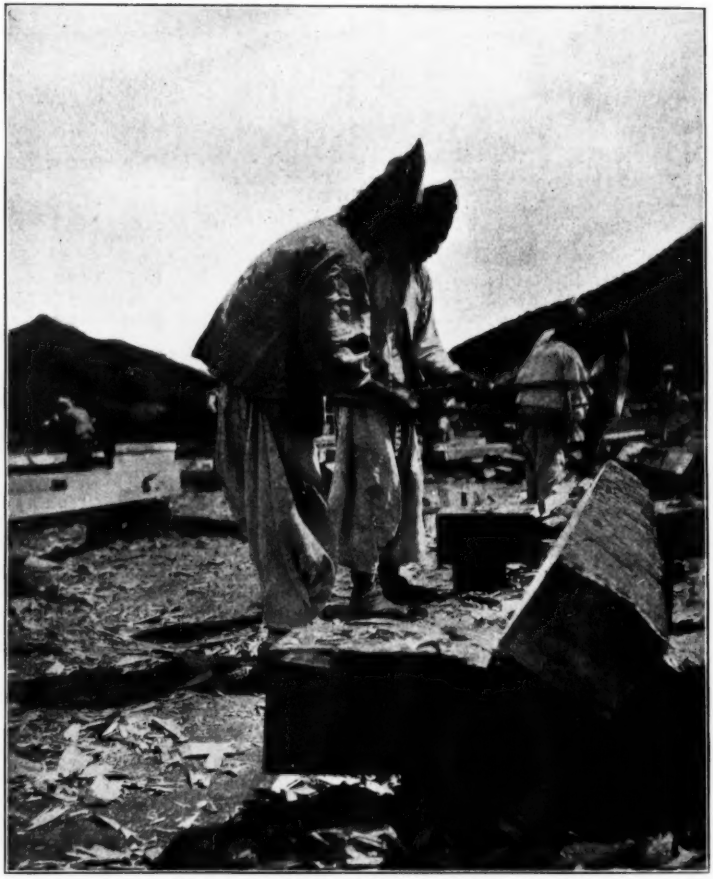
By Dr. A. Selwyn-Brown.

In two articles based upon official and authoritative data, Dr. Selwyn-Brown reviews comprehensively the present state and economic future of the mineral industries of Japan. This first part covers general conditions, mining law, methods and machinery, copper, and gold. A second part will deal with coal, iron, lead, zinc, and minor minerals. In view of Japan's manifest purpose and destiny as an oriental industrial power, this summary of basic resources is highly important. We are indebted to the courtesy of the Oriental Information Agency and the Allis-Chalmers Company for illustrations accompanying Dr. Selwyn-Brown's text.—THE EDITORS.

THE wonderful progress that Japan has made in the past forty years in developing her resources is due, in a very large measure, to the foresight and initiative of the Government. By means of a splendid educational policy and unique methods of finance, the Government has assisted the business men of the empire to extend its commerce in every possible manner. The result is that since 1874 statistics covering every phase of national activity exhibit a steady annual growth.

Japanese foreign trade in 1874 was valued at $21,400,000. Last year it amounted to over $500,000,000. Banking transactions, taxation returns and other financial records show a similar growth.

In addition to attending to the development of existing industries, the Japanese Government is always systematically searching for new openings for the energies of its people. Japanese experts are continually traveling around the world obtaining information and instruction, and seeking new methods for the extension of Japanese commerce and the exploitation of the Empire's natural resources. The success of the recent wars and the ability with which modern diplomatic and financial negotiations are carried out by the Japanese have afforded many remarkable objective illustrations of the thoroughness that characterises the efforts of the Japanese in the advancement of national ideals. It is proposed in this article to review briefly the Empire's mineral resources and indicate the manner in which they are being developed. But before doing so, reference will be made to the present extent of the Empire, the characteristics of the Japanese and their administrative methods.



KOREANS HEWING TIMBER FOR STAMP MILL.

The Empire of Japan comprises the four large islands of Honshiu, Hokkaido, Shikoku and Kyushiu, that have been members of the Empire for many centuries, and Korea, Formosa, a part of Saghalien, the Kiu Kiu, Kurile, Bonin and innumerable other groups of islands lying off the mainland coasts.

The population of Japan, not including the Koreans, is about 50,000,000. The people are hardy and vigorous, and are noted for their clannishness, inquisitiveness and acquisitiveness. They work

harmoniously among themselves, and in many of their habits resemble the Jews more than any other people; but they do not do well in contact with other people. They do not mix well with foreign people. It is partly through recognition of this fact that the laws of the Empire are so strict in limiting the rights of foreigners residing within the Empire. It is through the development and careful guidance of the national characteristics of the Japanese, that the Government has been enabled to advance the welfare of the country to such a wonderful extent in recent years.

TRANSPORTING MINE SUPPLIES, KOREA.

Modern Japan is absolutely developed by systematic educational methods directed by the Government. These methods are not exercised in the army, navy and government departments only, but are employed in every department of national activity. The foresight and completeness with which these works are undertaken is shown by the geological and mining reconnoitering and survey operations that were carried out in Korea, Manchuria, Saghalien and northern China during the late war. While the army was operating in the field, the whole of the geological and mining staff of the Government was carrying out geological surveys that would enable the Government diplomats to value the country surveyed and decide regarding its disposition at the settlement of the war. Before the war was over, good geological and mining maps and reports were printed by the Mines Department and Imperial Geological Survey and supplied to the diplomatic officers. Most of these maps and reports have since been translated and printed in English by the Geological Survey.

The Government, at the present time, is strenuously endeavoring to develop the mining and metallurgical industries of the Empire. In order to assist and control this development it has organized an unusually well-equipped Mining Bureau along the successful lines employed by various state governments in Australia.

For the purposes of the Mining Bureau, the Empire is divided into numerous mining districts. Each mining district has its administration office and officials. These offices are under the supervision of the Central Mines Bureau, which in turn is under the supervision of the Minister of Agriculture and Commerce.

The Bureau of Mines, which is supervised by a distinguished geologist, has administration over the following subjects:

I. 1. The granting of titles to mining properties and prospecting permits.
   2. The granting of water, power, railway and other rights for mining purposes.
   3. The cancellation of such titles and permits.

II. 1. The making and filing of plans of mining operations at regular intervals.
   2. The surveying of mining works.
   3. The amalgamation and division of mining claims.

III. 1. The management of the mining police, whose duties are to supervise the exercise of the mining regulations.
   2. The regular inspection of mines and metallurgical works.
   3. The investigation of the causes of accidents.

IV. 1. The general protection of the public's interests.
   2. The printing of scientific and technical reports on mining and mining districts.
   3. The collection of statistics.
   4. The carrying out of scientific experiments relating to mining and metallurgical problems.

V. The prevention and settlement of mining disputes concerning:
   1. Mining claims and titles.
   2. Labor.
   3. Minerals.
   4. Damages to private property through mining and metallurgical operations.
   5. Financial transactions relating to mining.
   6. Infractions of the mining laws and regulations.

The Mining Laws.

The Japanese Government learned the fact at an early date that good mining laws, efficiently administered, are necessary to insure the rapid development of a country's mineral resources. Consequently, much attention has been given to the mining laws.

All mineral rights in Japan are reserved to the Imperial Government, as they are in the most advanced Australian States. Consequently, there can be no troubles through mineral deposits being locked up on private property as in America. Miners and prospectors can go on to any property anywhere in the Empire, prospect for minerals, and when successful, acquire mining titles to their finds. Land owners, when they discover minerals on their own property, must secure mining rights from the Government and commence mining operations within a given time, otherwise, strangers may apply for mining titles. This beneficent legal principle has a wonderful influence in promoting the working of mineral discoveries. If a mineral discovery has any commercial value whatever, it will be developed by the prospector or by the land owner.

All mining, water power, dam, smelting, railway, residential rights and titles are granted subject to the rules and regulations of the Mines Bureau. These rules closely follow Australian practice. Mining leases may amount to not less than four acres for gold and silver mines and forty-one acres for coal, iron and other minerals. A maximum lease for any mineral must not exceed 817 acres.

The laws and regulations are designed to keep mining in the hands of the Japanese; but in order to secure capital for large operations, provision was made in the mining regulations of 1900 for the admission of foreigners as shareholders of corporations formed in Japan and incorporated under the Imperial Japanese corporation laws. Not many foreigners have availed themselves of this privilege. It may, however, be taken advantage of later when more prospecting work has been done in Korea, a country that gives promise of becoming a large mineral producer.

Mining Methods and Machinery.

The mineral resources of the Japanese Empire are varied and all classes of mining are carried on. In many of the small placer districts operations are carried out in a primitive manner. But on all the large mining fields, the mines are operated by powerful capitalists and large companies like Fujita & Co., the Mitsubishi Company, the Hokkaido

Colliery Co., Meiji Mining Co., the Mitsui Mining Co., and the Hoden and Nippon Oil companies. The mines operated by firms like these are equipped with the latest and finest mining, power and metallurgical machinery.

The largest part of the mining machinery used in Japan, according to the latest reports of the Imperial Mines Bureau, is imported from foreign countries. The makers of the best types of machinery in every part of Europe, America and Australia are represented by machinery on one or more of the Japanese mines. Most of the machinery is purchased in England or the United States. About one-half of the machinery imported is manufactured in Great Britain, about twenty-five per cent is made in America, the balance is purchased in Europe and Australasia.

The numbers and varieties of machines employed in mining operations in Japan in 1906 and 1909 are shown in Table I.

The number of persons employed in mining operations in recent years, and mining accidents, are shown in Table II.

The total values of the mineral production and mineral imports and exports in the period 1900-1909 are shown in Table III.

New mining investments in this period, 1905-9, were larger than at any previous period. The number of new mining companies incorporated in 1909 was 233, as compared with 132 in 1908 and 195 in 1907. The new capitalization in 1909 amounts to $90,650,000 in 1909, as compared with $85,500,000 in 1907.

WESTINGHOUSE ELECTRIC MINE LOCOMOTIVE, HOKKAIDO TANKO MINE, JAPAN.

TABLE I. MINING MACHINERY STATISTICS.

		1906		1909	
		No.	H. P.	No.	H. P.
Metal Mines	Boilers	163	9,543	190	15,000
	Engines	149	7,507	150	12,000
	Electric motors	279	10,720	563	20,000
	Oil and gas engines	28	1,679	29	1,400
	Water wheels	144	11,044	192	24,000
Non-Metal Mines.	Boilers	1,110	64,597	1,400	101,000
	Engines	1,573	64,389	2,360	94,000
	Electric motors	140	4,185	300	10,500
	Oil and gas engines	62	398	154	1,200
	Water wheels	0	0	3	300

TABLE II. MINERS AND ACCIDENTS.

Year.	Persons Employed.	Deaths From Accidents. Coal Mines.	Other Mines.	Total.
1903	157,129	215	94	309
1904	164,858	189	78	267
1905	154,975	256	74	330
1906	187,922	560	203	763
1907	214,435	468	113	581
1908	205,144	236	78	314
1909	212,000	440	114	554

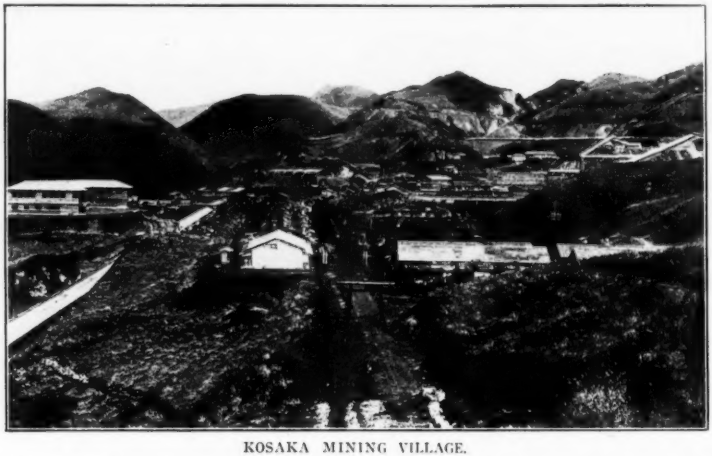
TABLE III. MINERAL STATISTICS.

Year.	Production.	Imports.	Exports.
1900	$25,000,000	$23,907,650	$11,180,500
1901	29,500,000	18,714,385	15,850,100
1902	29,900,000	17,938,450	15,067,550
1903	30,500,000	17,689,360	18,015,520
1904	31,000,000	28,696,770	12,777,845
1905	22,500,000	28,556,315	15,811,460
1906	57,990,000	24,745,075	21,613,330
1907	60,700,000	31,752,030	24,916,860
1908	58,190,000	27,551,045	20,512,630
1909	61,200,000	26,614,498	21,610,158

From the figures given in Table III we learn that the mineral industries of Japan are worth from $100,000,000 to $120,000,000 annually. The Empire's mineral output is much more valuable than the mineral imports and is greater than the imports and exports combined. Copper and coal mining are the most valuable of the mining industries. Copper and coal are the principal minerals exports; iron, steel, petroleum, phosphates, lead, zinc and tin are the principal imports.

Copper Mining.

The largest mining and metallurgical works in Japan are on the copper fields. A large part of Japan, Korea and the surrounding countries is composed of gneiss, biotite schists and granite of Archæan age. These are traversed by numerous intrusive dikes and faults that have introduced hydro-thermal mineral waters into the metamorphic rocks. Iron and copper sulphides were the commonest constituents of the metasomatic agents and, consequently, iron and copper sulphides are found wherever the Archæan rocks outcrop. Copper mines are being operated in every portion of the Empire. All classes



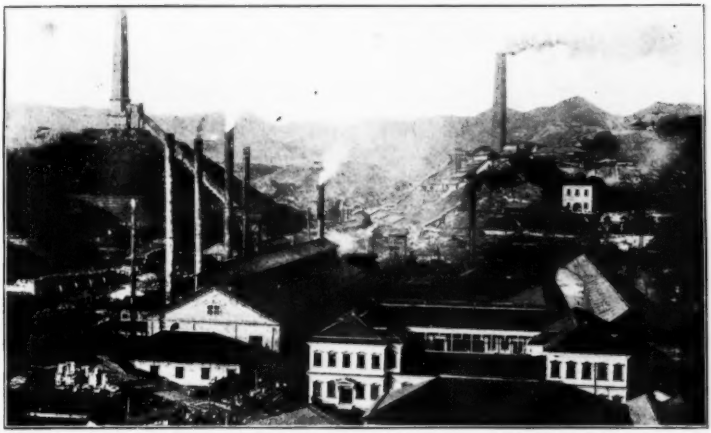
KOSAKA MINING VILLAGE.

of copper formations are being mined. The largest part of the copper ore is obtained from veins. Fifty-three of the largest mines that have been regularly operated during the past six years, and produced 45 per cent of the copper in that period, were operating on the following types of copper deposits:

Table IV. Types of Copper Deposits.

Type.	Number of Mines.	Per Centage of Relative Production.
Veins	32	54.0
Beds	17	26.6
Metasomatic deposits	3	18.0
Contact—metamorphic deposits	7	3.0

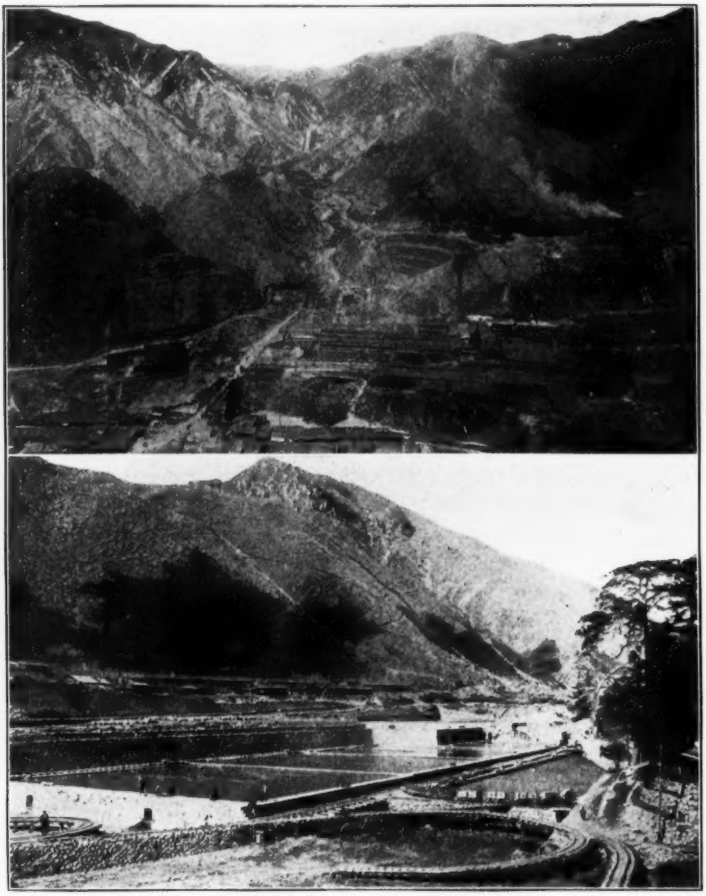
The Kosaka mine, owned by Fujita & Co., situated in the Province of Rikuchiu, is the largest and most important copper producer in



KOSAKA MINE. ADMINISTRATION BUILDING IN THE FOREGROUND.

Japan at the present time. Its annual output is between 6,000 and 7,000 tons of copper, 5,000 ounces of gold and 500,000 ounces of silver. The ore deposit is a cupriferous andesite occurring in the form of a bed about 600 feet in thickness that averages 2.2 per cent copper, 0.018 per cent silver and 0.00013 per cent gold per ton. The mining leases embrace an area of 300 acres. The deposit is mined by adit levels, cross-workings and open quarries. It is proposed in future

KOSAKA. MINING OFFICE ON LEFT.



THE COPPER MINES OF ASHIO.
Above, the mining village (in the background) and the mine entrance (left foreground); below, pond for purifying waste water before discharging it into the river.

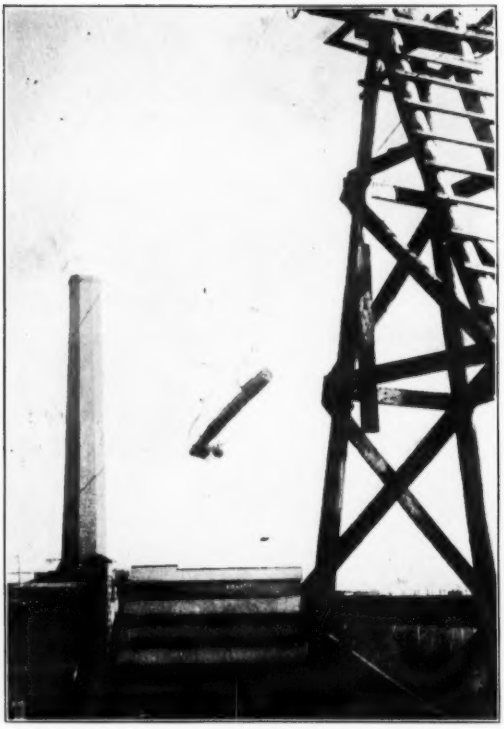
to obtain most of the ore by surface quarrying owing to the rapid oxidation of the sulphide ore causing numerous fires and vitiating the air in the mine workings. The main levels in the mine and the surface are lighted by electric lights. Water scoured electric and pneumatic machine drills are used in boring and drilling. About 5,000 persons are employed at the mine. About 800 of these are

employed underground. The mining plant is up-to-date. Power is generated in water turbines and Pelton wheels and transferred by electricity. The hydro-electric power plant has a total capacity of about 2,500 horse power. The ore is reduced by cold-blast pyritic furnaces and refined electrolytically. The mine is well-equipped and managed and is very profitable.

ASHIO MINING TOWN.

The Ashio mine is next in importance. It has an annual output of between 6,000 and 7,000 long tons of metallic copper. The ore is obtained in quartz veins in clay-slates, quartzite and sandstone formations of Palæozoic age. The ore is a complex mixture of galena, pyrites, arsenical and zinc sulphides, and of chalcopyrite, gold and silver. Mining is done through vertical shafts and by levels that are well-equipped with hauling and mining machinery. Hydro-electric generators supply power for all purposes and the mine is lighted by electric lamps. About 8,000 persons are employed at the mine, 3,200 of whom are engaged in mining, 500 in smelting the ore, and the balance in transportation and other works connected with the mining and marketing of the copper. The ore is Bessemerized in the company's Nikko smelter and the copper is refined by electrolytic means. Much of the copper produced is worked up into commercial forms by the company, and the works are equipped with machinery for turning out copper wire, tubes, bars and sheets.

The Besshi mine is the largest producer among the mines operating on bed deposits. This mine was discovered in 1690 and has been



AERIAL TRAMWAY FOR CARRYING TIMBER TO ASHIO MINE

worked almost regularly since. It is estimated that up to the end of last year it has produced over 1,927,560 long tons of metallic copper. The workings are situated in a mountainous region at an altitude of 3,500 feet above sea level. The ore occurs in a chloritic schist formation that is traversed by numerous eclogyte dikes. The cupriferous bed is from 4 to 30 feet thick and over 5,000 feet in length. It dips at an angle of 45 degrees and has been mined to a depth of 2,300 feet on the incline. Pyritic smelting is practiced and power for the mine and smelting works is generated by hydroelectric machinery. The mine and smelter give employment to 2,300 men.

The Hitachi mine yields about 2,000 long tons of copper annually. This is also a bed mine. The ore occurs in a bed of amphibolite schist from 10 to 20 feet thick. It averages 5 per cent copper and carries gold and silver. The mine is well equipped with machinery. Machine drills are used in stoping. The company owning the property has its own smelters and owns the electric railway connecting the mine with the smelting works. Power is obtained from a hydroelectric plant. This is a comparatively new mine and promises to become a more important producer in the future.

Among the other important copper mines in the Japanese Islands are the Osaruzawa, with an annual production of 2,000 long tons of

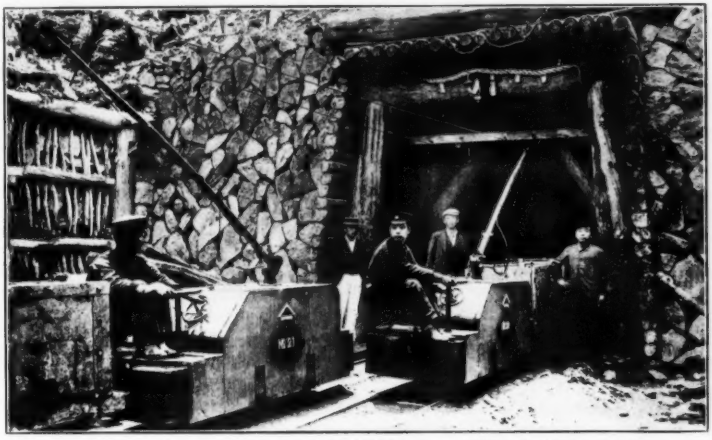
copper; the Ani, 1,500 tons; Ikuno, 1,300 tons; Kano, 1,000 tons; Hibira, 900 tons; Yoshioka, 850 tons; Obiye, 800 tons; Arakawa, 750 tons; Hisanich, 700 tons; Ogoya, 700 tons; Furokura, 600 tons; and the Makimine, 550 tons. There are about thirty other mines producing between 100 and 500 tons of metallic copper yearly.

Copper occurs in many parts of Korea, but the Kap-San mine is the only important producer at present. The ore in that property is chalcopyrite mixed with arsenopyrite and pyrrhotite. It occurs in irregular masses in a limestone formation. The average value of the ore is 12 per cent copper, 45 per cent iron and 37 per cent sulphur per ton.

The copper production of Japan is summarized in Table V.

TABLE V. COPPER PRODUCTION IN JAPAN 1890-1909.

	Long Tons.		Long Tons.
1890	17,849	1900	24,939
1891	18,754	1901	26,990
1892	20,423	1902	29,144
1893	17,750	1903	32,111
1894	19,622	1904	31,653
1895	18,834	1905	34,975
1896	19,784	1906	37,950
1897	20,091	1907	39,556
1898	20,716	1908	41,113
1899	23,920	1909	43,000



ELECTRIC LOCOMOTIVE AT THE ENTRANCE TO A MINE TUNNEL, ASHIO.

Gold Mining.

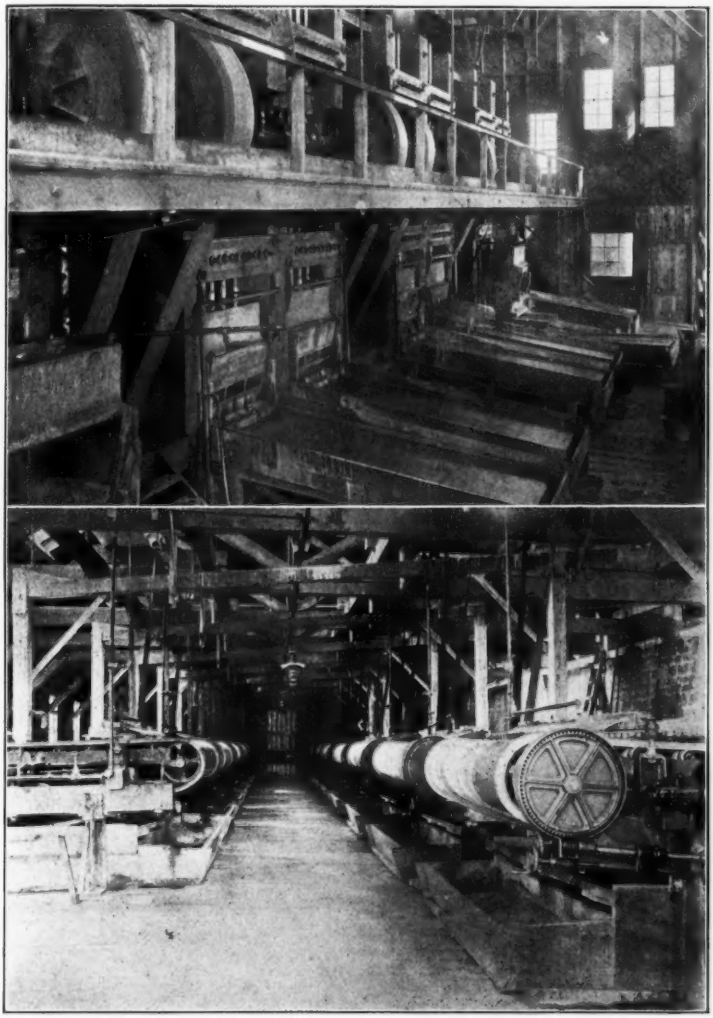
Gold has been found and worked throughout the Japanese Islands since the earliest times, but important gold workings are at present confined to a few restricted districts. The best known mines are in the northern parts of Formosa, the Province of Satsuma, and the northeastern portions of Honshu. Gold occurs in placer deposits, in combination with copper and other ores and in quartz veins. The most important vein mines are the Ponshi Karibets, Matsuoka, Handa, Takadama, Aikawa, Kuratani, Kosen, Sado, Hasami, Ushio, Okuchi, Yamagano, Botanko, Kinkwaseki, and the Dzuiho.

MAI-BONG GOLD MINE AND MILL, ORIENTAL CONSOLIDATED CO., KOREA.

The Sado mine yields between 13,000 and 14,000 ounces of gold per annum, valued at $20 per ounce. The ore is mined from quartz veins by means of four vertical shafts between 1,000 and 1,500 feet in depth. The mine is electrically lighted, and is well equipped with machinery. It has a stamp and concentrating mill, a cyanide plant and a smelter for the treatment of the lead and copper concentrates. The metallurgical treatment of the ore is as follows: It is stamped in the battery, passed over amalgamated plates and shaking tables, thence over Duncan concentrators and vanners. The lead and copper concentrates are smelted in a blast furnace with iron and marl fluxes.

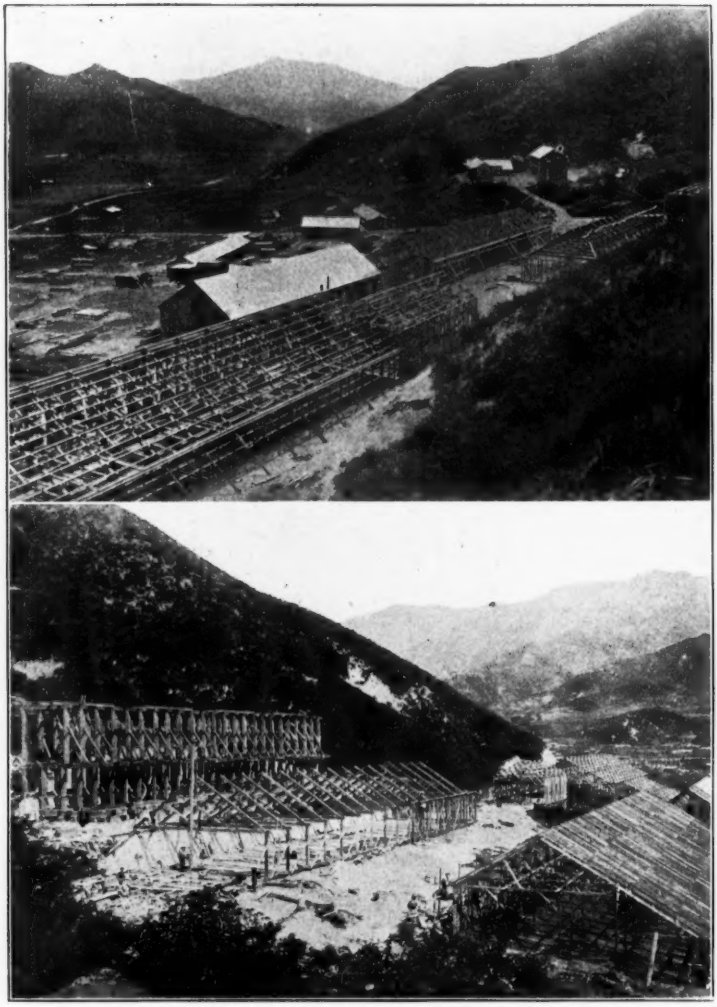
The production of the Sado mine in recent years was as follows:

Year.	Ore. Long Tons.	Gold. Ounces.	Silver. Ounces.	Copper. Long Tons.
1904	55,610	10,100	100,989	11
1905	71,612	11,595	91,501	6
1906	71,123	12,054	99,615	14
1907	71,941	13,184	116,991	6
1908	81,510	13,740	113,652	4



AMALGAMATING AND CONCENTRATING FLOORS, MAI-BONG MILL, KOREA.

The Ushio mine contains a 6-foot quartz vein traversing an augite andesite formation. About 20,000 tons of ore are mined annually for a yield of 10,000 ounces of gold and 6,000 ounces of silver. The bullion is obtained by amalgamation in a stamp mill and by a cyanide plant dealing with the concentrates. Hydroelectric generators are



YARACOL GOLD CAMP, KOREA. MILL AND CYANIDE PLANT.

employed for supplying power. The mine is lighted by acetylene lamps.

The Kinkwaseki mine, in Formosa, contains quartz veins traversing tertiary slates and sandstones. The ore is a mixture of pyrite, chalcopyrite, zinc blende, galena and cinnabar. The veins are from

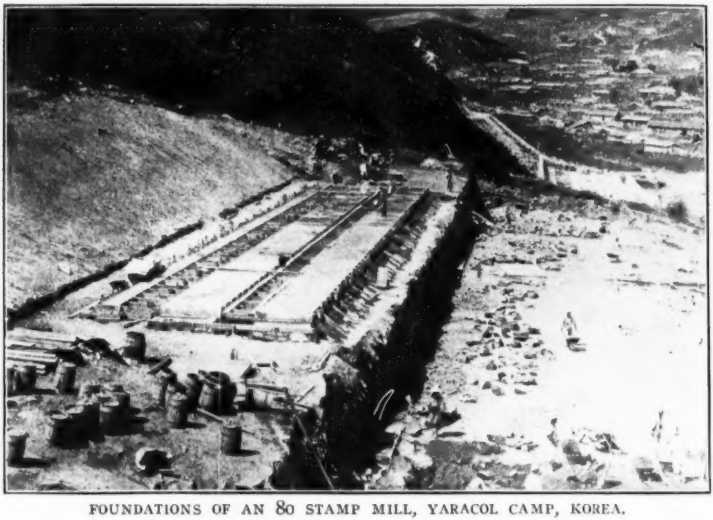
6 to 10 feet in width and have been opened to a depth of 950 feet. Hydroelectric and steam power plants are employed and stamps and cyanide plants treat the ore and tailings. The yields in recent years were as follows:

Year.	Ore. Long Tons.	Gold. Ounces.	Silver. Ounces.	Copper. Long Tons.
1904	20,000	20,571	4,024	..
1905	19,375	28,585	6,081	..
1906	25,057	16,707	4,229	..
1907	25,721	14,555	8,428	46
1908	31,054	33,353	25,558	319

The Botanko and Dzuiho mines are also in Formosa. The former yields between 15,000 and 20,000 ounces of gold and 4,000 ounces of silver per year. The Dzuiho yields 10,000 ounces gold and 5,000 ounces silver per year. Both mines are well-developed quartz-vein properties, and are well managed. The mills contain stamper batteries, Huntington mills, the latest types of concentrating machinery and cyanide plants.

YARACOL CAMP, ORIENTAL CONSOLIDATED COMPANY, KOREA. YOUCAL VILLAGE IN BACKGROUND. FRAMING YARD AND BLACKSMITH SHOP.

Gold occurs in many parts of Korea in placers, veins and disseminated in rock masses. It is mined in all these forms. The principal gold veins are mined by the Oriental Consolidated Mining Company of New York, the British-Korean Corporation and the Shibusawa and Asano Company.



FOUNDATIONS OF AN 80 STAMP MILL, YARACOL CAMP, KOREA.

The Oriental Consolidated Company operates five mines in Un-San County. The Shibusawa and Asano Company operates the Chik-San mine, and the British-Korean Corporation owns the Ap-Eun mine. All these properties are well developed and equipped with extensive modern mining, metallurgical and power plants, and are profitable. Numerous other gold mines are successfully operated by Korean, Japanese and Chinese companies. Japanese miners are doing a large amount of prospecting work in Korea at present and it is probable that their activities will result in considerably augmenting the gold yields of Korea, and of the Japanese Empire, within the next few years. The recent gold production of Japan is given in Table VI.

TABLE VI. GOLD PRODUCTION OF JAPAN.

Year.	Ounces, Troy.	Value, Dollars.	Year.	Ounces, Troy.	Value, Dollars.
1890.....	23,362	247,050	1900.....	80,596	1,625,621
1891.....	23,217	264,770	1901.....	101,683	2,334,230
1892.....	22,523	279,525	1902.....	143,993	2,826,970
1893.....	23,676	305,650	1903.....	139,623	2,770,140
1894.....	25,260	400,580	1904.....	132,814	2,728,435
1895.....	40,898	531,065	1905.....	148,645	3,064,515
1896.....	30,928	485,515	1906.....	132,986	2,799,100
1897.....	33,617	603,790	1907.....	134,153	2,773,700
1898.....	39,303	714,695	1908.....	168,883	3,493,760
1899.....	58,654	1,190,015	1909.....	170,000	3,400,000

THE NEW ERA IN ELECTRICAL ILLUMINATION.

By Rollin W. Hutchinson, Jr.

Mr. Hutchinson's review, while not neglecting the technical aspects of the newer achievements in electric lighting, will perhaps most interest readers of this magazine by its concise and practical information as to the service characteristics and relative economy in operation of the new systems and equipment. The present article is devoted to metal-filament lamps. A following section will take up the principal forms of flaming-arc and vapor lamps.—THE EDITORS.

FOR nearly twenty years after the historical lighting of Menlo Park, New Jersey, in 1879, with Mr. Edison's carbonized-bamboo-filament incandescent lamps, the improvements in both incandescent and arc types of electric-light sources consisted more in the perfection of details than in the evolution of lamps of higher efficiencies. The low efficiencies of existing electric-light sources were the continual deprecation of the technical press. True, the appearance of "metallized" carbon lamps in the early years of the present century marked a new era in incandescent lighting, yet serviceable and economical as such lamps are, they are very inefficient as compared with the class of lamps of which they are the progenitors—the metal-filament lamps.

Following the announcement of Bremer's flaming arc lamp in 1899, came the startling advice (1903) that incandescent lamps employing filaments of the metal tantalum exhibited the remarkable efficiency of two watts per candle power and gave illumination approaching daylight in color value. Hardly had this announcement appeared before the illuminating-engineering world was again aroused from its accustomed indifference and cynicism by the almost incredible news that the rare metal tungsten (wolfram) could be employed as the resisting medium in vacuum lamps, and produce an efficiency of a small fraction over one watt per candle power, and that with a color value nearer like daylight than any other illuminant.

Since the commercialization of the metallic filament, flaming and luminous arc lamps, the electric-lighting industry, within the past three years, has been revolutionized, and central stations are still adjusting themselves to the new conditions imposed by the modern high-efficiency illuminants.

OUTDOOR ELECTRIC ILLUMINATION BY SERIES MAZDA LAMPS, CENTRAL PARK, NEW YORK.

The commanding importance of the tungsten lamp at the present moment in the electric-lighting industry is one of the most astonishing phenomena in the history of artificial illumination. After more than twenty-years usage of the ordinary carbon-filament incandescent lamp that underwent but slight improvements in efficiency during that time, and with arc lamps that degenerated from the one watt per candle-power open arc to the almost three watts per candle of the enclosed alternating-current arc, it is remarkable that artificial illumination should suddenly and almost simultaneously be produced by substitutes for both types with an increase of efficiency in both cases greatly exceeding the most extravagant hopes of the optimists in the art of illumination.

Hardly more than two years since, electric-lighting officials believed that the changes of lighting-plant business policy to adapt the industry to the new situation introduced by the metallic-filament lamps, might gradually be made on account of the slowness of manufacturers in supplying these lamps. At this writing, however, the supply of the new incandescent lamps is approaching the 125,000 per day mark, which number is being further increased by the importation of foreign lamps, while the output is being increased daily. With the present large and growing rate of production, and the fact that the new lamps have a life more than twice that of the carbon lamp with at least two-thirds less energy consumption, it should not be more than a few months before the heavy demand for the new illuminants will be met. At present most attention is centered on the higher candle-power metallic-filament lamps, principally for the reason that they offer admirable means for supplanting gas arcs and carbon electric arc lamps for street and commercial lighting, although the betterment of the art by the introduction of metallic-filament lamps for interior illumination as substitutes for the ordinary carbon-filament lamps is receiving constant attention.

The rapidity of introduction of the new lamps is somewhat augmented by the fact that the present cost of the lamps is not given great weight in formulating the policies of lighting plants. The price of metallic-filament lamps in Europe was halved almost within a year, and as periodical notices of further reductions are being made there is no reason for believing that the present scale of prices will be maintained in the United States.

It can be safely stated that the metallic-filament lamps are on a practical commercial basis and are factors in the lighting field that

cannot be ignored, and that bid fair to supplant all other illuminants where electric service is available.

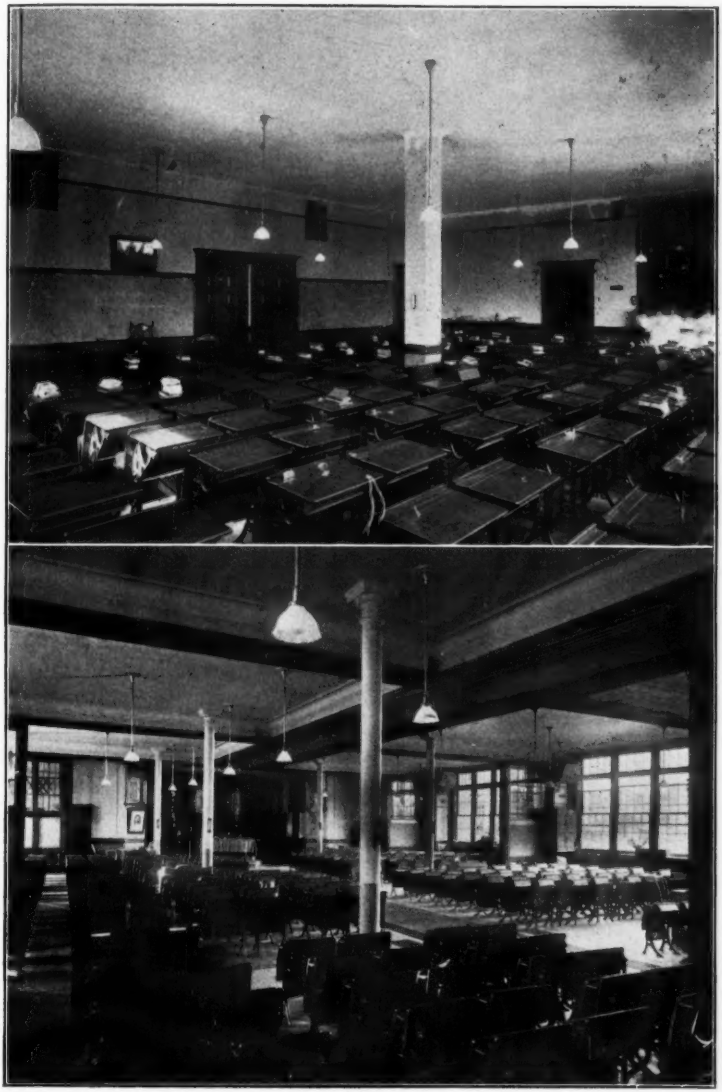
The aim of scientists and inventors since the introduction of the carbon-filament lamp has been to produce a light source which would broaden the field of electric lighting. The attainment of this end, up to the present time, has been reached with the metallic-filament lamps, particularly the tungsten-filament lamp. How early these new illuminants will by the constant process of evolution be supplanted by lamps of higher efficiency the future alone can tell. Investigators never attain the goal of their efforts, and the encouraging results obtained with still other rare minerals when employed for incandescent lamp filaments engender the belief that it only will be a few years before the present methods of incandescent-lamp lighting will be radically improved.

The desideratum in the development of artificial illuminants has been to produce a light source of maximum efficiency, or in other words, a light with the minimum of heat—a "cold light" like that with which Nature has endowed the firefly of our summer evenings. The goal, while considerably in the future, is much nearer than it was ten years ago.

This commercial application of the so-called high-efficiency lighting sources has directed the attention of the manufacturers of various illuminants such as the Nernst, Gem, Tantalum, Cooper-Hewitt, and other vapor lamps for the time being away from the problem of efficiency, and centered it upon the quality, color value, and uses of these light sources. Such a hiatus in the problem of efficient development of electric illuminants has greatly benefited the esthetic side of the art. Prior to the time when the tungsen lamp was put on a commercial basis, the electric-lighting art, if not, in fact, the whole art of artificial illumination, was in the embryonic state.

The expensive and frequently prohibitive cost of installation and operation together with only unsatisfactory light quality and poor efficiency of the high-candle-power lamps then available retarded agreements as to a true standard of illumination. The advent of the Gem and tantalum high-candle-power lamps inaugurated a marked improvement, since at one stroke the economy and illumination by electricity was improved, and the new era of single unit illumination dawned.

At this stage of development the value of reflecting and diffusing shades and reflectors was revealed. The high intrinsic illumination emitted by the new filaments coupled with their concentrated bril-



A GOOD EXAMPLE OF MODERN SCHOOL ROOM ILLUMINATION. PHOTOGRAPHED BY THE ARTIFICIAL LIGHT.

Above, 125-watt, and below 150 and 187.5-watt Gem lamps with holophane reflectors.

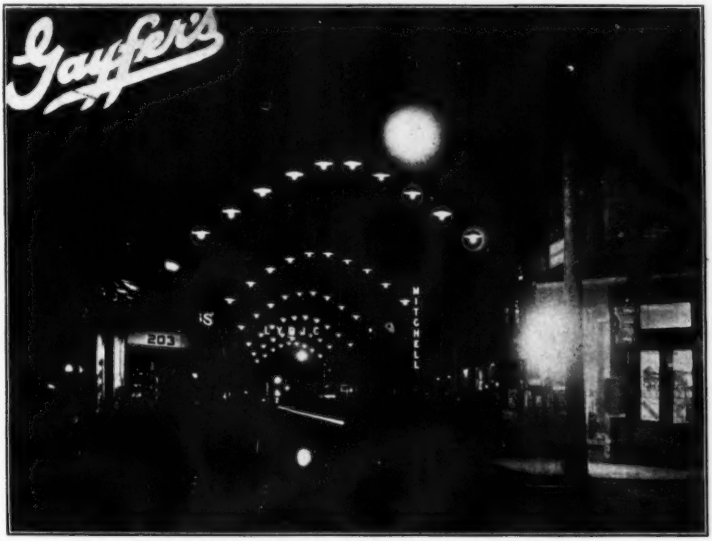
EFFICIENT DISPLAY WINDOW LIGHTING.
Holophane d'Olier shade with 40-watt Mazda lamps for windows; 12-inch hemisphere in entrance.

liancy, rendered essential the use of some arrangement to direct the light radiation where it would be usefully employed for the purpose desired. This necessity created the new art of reflector design in which scientific requirements had to be met. The day of the white enameled cone and the flat glass plate, which crude aids to the uniform light distribution served the carbon-filament lamp after a fashion, passed. At first glassware of curious shapes and sizes was evolved, but on account of its high absorption power proved more or less unsatisfactory. The solution was found in prismatic glassware in which the well-known principles of refraction and reflection are utilized to diffuse the light uniformly instead of merely reflecting it.

It is quite a singular fact that the initial invention of the metallic-filament lamp was made in the United States, although the commercialization of the lamps was developed by European scientists. The daring and skill of American manufacturers, however, has resulted in equalling if not excelling Continental concerns in perfection of the details of metallic-filament lamps. In the case of prismatic reflectors, however, the reverse is true. While the original prismatic reflectors were imported from Europe the ingenuity of American manufacturers has perfected the methods of manufacture. The scientific principles of illumination are being developed as an art instead of being utilized as mere details of lighting arrangements.

The metallic-filament lamps have begun to displace a number of other illuminants, both gas and electric, and for interior as well as exterior illumination. For interior lighting their high candle power and illuminating value renders possible the adoption of more delicate and harmonious color effects than ever before attained. Even in art galleries where the peculiar requirements of proper artificial lighting have been unsatisfactorily met by other light sources, the metal-filament lamp has given the proper results. The new incandescent lamps are also gradually making obsolete the open and closed types of arc lamps—gas and electric—for street lighting. As an aid to department stores, tradesmen, and shop-keepers of all kinds, the value of the metallic-filament lamps when properly installed is evidenced by the natural effect it produces in displaying wares to the best advantage.

Despite the growing field of usefulness which the tungsten lamp serves it is likely that the carbon incandescent lamp will continue to be utilized to a certain extent for lighting where economy is no great object, and in the numerous sockets where intermittent lighting only is required. This is evidenced by the fact that the output of carbon incandescent lamps in 1907 was equal to that of the boom year of 1906 but has shown a decided falling off in the last two years.



SERIES MAZDA LIGHTING, DAUPHIN ST., MOBILE, ALA.

The possible limits of incandescent electric-lamp efficiency appear to have been reached in the newer types of metallic filaments described in the pages to follow, yet who knows but that lamps using more refractory substances or giving more selective radiation of light will be produced? At the present time it would seem that the only recourse for still improving the luminous efficiency of incandescent lamps is either in the production of refractory materials with higher temperatures of volatilization for working limits, and of melting for margin of overload; or in the discovery of a filament having selective radiating properties, or in other words, one which will radiate more within the visible range of frequencies and less within the invisible range. The two features desired are not necessarily interdependent, as the property of resisting higher temperature without melting may be separate and distinct from the property of selective radiation. Perhaps no advantage will be found in selective radiation, in which event the use of highly refractory filaments will become necessary. If the solution of the problem of gaining still higher efficiencies in electrical illuminants is attempted by departing from the single incandescent lamp, the outlook is better for obtaining higher efficiencies from incandescent gases on account of the fact that all such gases radiate selectively. Hence the future for the lamp of glowing vapor appears brighter than that of the lamp of the glowing solid.

The Efficiency of Electric Illuminants.

Efficiency of illumination is properly stated in terms of mean spherical candle-power per watt at the lamp terminals. The definition of efficiency as applied to artificial illuminants is not strictly correct as no means of determining the energy equivalent of light have as yet been devised. In practical illuminating work efficiency is understood to mean the candle-power per watt.

Efficiency of illumination may be defined as the combined effect of three different kinds of efficiencies viz: (1), Efficiency of visual perception, or the efficiency with which the eye receives light energy and translates it into visual perception. (2), Efficiency of light distribution, or the relation between total light energy generated and the light energy useful in producing desired conditions for visual perception. (3), Efficiency of the light source—i.e., the efficiency with which the chemical or electrical energy is transformed into light energy. Visual-perception efficiency is influenced by three conditions: (1) The intrinsic brilliancy of the light source and the light-reflecting objects. (2) The color of the light. (3) The steadiness and intensity

of the light. Analyzing the conditions still further, it should be stated that efficiency in light distribution depends upon three important factors: (a) the distribution of light emitted by the illuminating unit; (b) the size of the unit and (c) the location of centers of light distribution.

TUNGSTEN.

Tungsten (German wolfram and sometimes so termed in English-speaking countries) is one of the rare metals, is of iron grey color and is so very hard that it can scratch glass. Its specific gravity is 19.1 (nearly equal to that of tantalum), thus being one of the heaviest of metals. It was discovered by Scheele in 1780. Until very recent years tungsten has been known to most electrical engineers only as the metal, which, when added to German silver to the extent of one or two per cent, made the alloy platinoid, which possesses a remarkably high resistivity, the value of which varies only slightly with great temperature changes.

Like osmium and tantalum, tungsten has a lower resistivity than carbon, which gives rise to the same difficulties in producing high-voltage lamps of tungsten that there is in producing high-voltage lamps of osmium and tantalum. Pure tungsten does not melt but volatilizes directly at a temperature considerably in excess of that at which the ordinary carbon filament is supposed to volatilize. This accounts for the marked increase in luminous efficiency of the tungsten lamp as compared with the carbon-filament lamp. The melting point of tungsten filaments has been determined by Waidner and Burgess to be 3,200 degrees C.

Tungsten is commercially obtainable in the form of a fine powder. The ductility of the metal is so low that it is impossible to draw it directly into a fine wire, which is quite practicable with a tantalum filament. Tungsten unites readily with oxygen and with carbon at high temperature. Hence the problem of producing tungsten filaments is extremely difficult.

THE AUER PROCESS OF MAKING TUNGSTEN FILAMENTS.

The processes and methods employed in the manufacture of tungsten lamps are both numerous and diversified, and while the majority of these are still in the experimental stage a number are in successful use and deserve detailed discussion.

In the "paste process," originally developed by Auer in the manufacture of the osmium lamp, finely divided tungsten is mixed with a suitable binder and the resulting paste is forced through diamond dies under powerful pressure. The paste is thus shaped into the proper

form for a filament, which is then heated in an atmosphere of steam and hydrogen to remove the carbon in the binding material, the refined filament consisting of almost pure tungsten.

Just-Hanaman Process.

In the process perfected by Doctors Alexender Just and Franz Hanaman, patented May 28, 1907, which is used in the manufacture of the Just lamp, a large number of which are in use in the United States, a fine filament of carbon is heated in the presence of finely divided tungsten or some tungsten compound which is readily reduced by carbon to a metal. The compound of the metal may be either tungsten oxide, tungstic acid, or tungsten sulphide. The tungsten compound is mixed with an organic binding material, such as a solution of cellulose in chloride of zinc, collodion, coal tar or the like. The filaments are then formed by pressure through a die in the usual manner, and afterwards (subsequent to denitration if collodion is employed) the filaments are carbonized. The quantity of tungsten compound used in the mixture is such that in the finished filament sufficient carbon is always present to impart the necessary strength to it, as the filament depends upon the carbon alone for strength to withstand the subsequent treatment. The specifications state that efficient filaments are obtained if from 2 to 10 grams of tungsten acid are added to a solution of 10 grams of cellulose in 260 grams of chloride of zinc whose specific gravity is 1.83. This mixture is then formed into filaments and carbonized in the absence of air and is then subjected to the following additional treatment. An electric current is passed through the filament in an atmosphere of the vapor of one of the oxyhalogen compounds of tungsten, such as tungsten oxychloride, in the presence of a little free hydrogen. Incandescing of the filament causes a reaction whereby the carbon still retained in the filament is replaced by tungsten.

Kuzel Process.

This process, the invention of Dr. Kuzel a German electrochemist, consists in forming an arc between tungsten electrodes under water or possibly some other liquid, forming a so-called colloidal solution, which is then brought to the proper consistency and squirted through diamond dies. The chief advantage of this method over the two preceding ones lies in the absence of any organic matter which when present is completely removed only with the greatest difficulty, and if allowed to remain tends to reduce the life and serviceableness of the filament. The American rights to this process have recently been acquired by the General Electric Company.

General Electric Process.

A method very radically different from these two is that patented by the British Thomson-Houston Company and perfected by the General Electric Company in America. By this process the metal tungsten is rendered sufficiently ductile to be drawn into a wire, which formerly had been considered impossible. The method consists in reducing an oxide of tungsten and mixing the powder thus obtained with an amalgam of cadmium. The plastic mass which is made is pressed through a die in the usual manner and the cadmium and mercury are then driven off by heat. The filament so formed possesses the usual brittleness, but after being heated to a moderate temperature it becomes pliable and may be readily bent into any desired form. It is claimed that it is possible by this process to draw tungsten wire from rods of the metal prepared as above described by simply maintaining the metal and the dies at the proper temperature. This method is therefore one of the most promising in use at the present time as the fundamental difficulties in the making of tungsten filaments is that tungsten is not ductile and unites readily with carbon and oxygen.

The "Z" Tungsten Lamp.

This is a process in which finely divided tungsten is squirted with an organic binding material through dies, the organic material being subsequently removed. The lamp is of the multiple filament pattern, the filaments being in the shape of a hair-pin, grouped around a central glass support and connected in series. The filaments are supported by carbon hooks attached to the center stem by thin steel wires. The combination of steel wire and carbon hook forms a spring support which compensates for the expansion and contraction of the filament, and at the same time dampens the vibrations. To prevent blackening of the lamp a "special salt" is painted on the central glass stem. The initial consumption of the "Z" lamp is claimed to be 1.15 watts per candle, with an average loss of 1 per cent in candle-power for each 100 hours of burning.

Support of Tungsten Filaments.

On account of the low resistance of tungsten the filament must be either of very small cross-section or of considerable length. To make the filament of suitable length for use in incandescent lamps a compromise between these two features must be made. Even then the length of the filament is so much greater than that of the carbon incandescent lamp, and the tungsten filament is so soft when heated, that

a method of supporting tungsten filaments is used radically different from the ordinary method employed in carbon lamps.

Useful Life, Radiating Power and Temperature of Tungsten-Lamp Filaments.

Of all metals which have been investigated up to the present time, only pure tungsten has a life as high as 1,000 hours when operated at about one watt per Hefner candle-power. The following figures show an interesting comparison between the electrical energy consumed and the light radiated from the surfaces of tungsten and carbon filaments. One square millimeter of tungsten filament gives 0.50 candle-power and consumes 0.55 watt; one square millimeter of carbon filament radiates 0.182 candle-power and requires 0.63 watt. Thus the tungsten filament consumes only 80 per cent of the power taken by an equal surface of the carbon filament but gives 275 per cent of the light given by the carbon filament.

In a paper read by H. Hirst before the British Institution of Electrical Engineers, the author states that "if the kind of radiation were the same in both cases, the carbon filament ought to get hotter than the tungsten filament by about 60 degrees C. because of the higher total radiation consumption per unit of surface. On the other hand, considering the greater light emanating from the tungsten filament, its temperature ought to exceed that of the carbon filament by about 200 degrees C. These contradictory conclusions show clearly how different is the radiating power of the tungsten filament as compared with the carbon filament. The latter behaves more like the "black body" of the radiation theory. Approximate calculations show that the temperature of the tungsten filament, when consuming 1.1 watts per candle-power, is about 250 degrees C. higher than that of a carbon filament taking 3.5 watts per candle-power. If a carbon filament were to be over-run to such an extent as to consume only 1.1 watts per candle-power, its temperature would have to be raised by 360 degrees C. The favorable radiating properties of the tungsten filament, therefore, mean that its temperature is 100 degrees lower than that of a carbon filament of the same specific consumption. If it were not possessed of this radiating property it would have to be operated at a consumption of 1.5 to 1.6 watts per candle-power, in order that it might have the same life it actually possesses at 1.1 watts per candle-power.

If one takes the resistance of carbon, tantalum, osmium and tungsten filaments at ordinary temperatures, the resistance at those tem-

peratures, which in a vacuum correspond to 1.5 watts per candle, will be as follows: For a carbon filament 0.55 times the original; for tantalum 5.70 times; for osmium 8.50 times; for tungsten 11.00 times. Under normal conditions the light of a carbon-filament lamp rises and falls with the 6.3 power that of the tungsten filament with the 3.6 power of the voltage.

EFFECT OF VOLTAGE VARIATION ON THE LIFE OF TUNGSTEN LAMPS.

It is not as highly essential to maintain a uniform voltage at the terminals of a tungsten lamp as upon the terminals of a carbon-filament lamp. The effect of over-voltage on a tungsten lamp is not so serious a factor in reducing the useful life of the lamp as is the case with the carbon-filament lamp; however, this should not be interpreted to mean that the supplying voltage may be allowed to fluctuate within wide limits without injurious effect. The relation between actual life and useful life (the latter being defined as the number of hours within which the candle power drops to 80 per cent of the original value), is quite different with carbon lamps and metallic-filament lamps. When metallic-filament lamps are operated at normal voltage the actual life is longer than the useful life. In other words, if a tungsten lamp is carefully handled, kept free from vibrations, and operated at normal voltage, it will decrease in candle-power to 80 per cent of the original value after 1,800 hours of burning. Under average conditions of burning, however, the filament will break before that time and if breakage occurs, for example, after 1,000 hours of burning, the candle power will have dropped by only 7 per cent of the original value. If the working voltage is higher than normal, both the useful life and the actual life decrease but the useful life falls off more quickly.

If the voltage is increased above the normal, the increase of power consumption should be proportional to the square of the voltage if the resistance of the filament remained constant. But since the resistance also increases, the energy the lamp takes increases less than the square of the voltage.

Fragility of the tungsten filament has been so far the chief drawback to the new lamp but there is evidence of material improvement in this particular. The lamps can now be shipped without much trouble and can be distributed with very small breakage. In a shipment of 75,000 one large lamp maker reports a breakage of less than 1.5 per cent, which is indeed remarkable, considering the extreme fragility of the first tungsten filaments. But when the lamps are put in the hands of the user trouble begins. It is a very singular fact that the fragile filaments will at times endure abuse and at still other times

KNITTING-MILL ILLUMINATION BY 60-WATT MAZDA LAMPS AND HOLOPHANE REFLECTORS. NOTE THE "ALMOST-LIKE-DAYLIGHT" EFFECT.

almost an imperceptible jar will fracture them. Sometimes merely overhead vibration, a rough handling of the key socket, or a tap on the shade may break the filament. Hence one cannot exercise too much care in handling or cleaning metal-filament lamps. However, considering all the chances of breakage, the life of the new lamps is remarkably good.

The introduction of the 25-watt lamp, while of great importance in leading to better economy, is very likely to lead to more temporary difficulty from breaks. The filaments of these small lamps are exceedingly slender, and while of long life in the matter of burning, they cannot stand the shocks of thicker filaments. In an admirable editorial entitled "The Tungsten Lamp Situation," *The Electrical World* of January 2, 1909, thus speaks of the caution to be observed with the smaller candle power metal filament lamps:

> A word of warning seems to be in order about the 25-watt tungsten lamp. It is certainly a most handy size and one that is bound to be popular, but it must be dealt with rather cautiously. It is somewhat more fragile than others of its kind and while it gives excellent life if let alone it will not generally stand rough treatment. If there is need to clean the shade the lamp should first be lighted and current kept on until cleaning is done. * * *

ANALYSIS OF COST OF OPERATION OF TUNGSTEN AND CARBON LAMPS.

On account of the relative scarcity of tungsten ores, the high tariff on the importation of such ores under the new Payne-Aldrich tariff bill, and the tedious and complex processes of manufacture, the initial cost of the tungsten lamp is considerably more than that of the carbon lamp. This high first cost is however more than compensated for by the longer life and the superior efficiency of the tungsten lamp.

As an example of the economy of the tungsten lamp over the carbon lamp we will take a 40-watt (32 candle-power) tungsten lamp and a 32 candle-power carbon lamp and compute the total cost of each of these lamps when burned the same number of hours at the same price per kilowatt hour.

The high-efficiency carbon lamp has an efficiency of 3.1 watts per candle power, hence the total wattage of the 32 candle-power lamp is 99.2. Its guaranteed life is 430 hours, making its total energy consumption $430 \times 99.2 = 41{,}156$ watt hours, or 41.15 kilowatt hours during its useful life. With energy at 10 cents per kilowatt hour, its cost of operation is $41.15 \times .10 = \$4.11$, to which should be added the first cost of the lamp, 30 cents, making its total cost \$4.41.

The 40-watt tungsten lamp has a useful life of 800 hours producing a total energy consumption during its useful life of $40 \times 800 = 32{,}000$

watt hours or 32 kilowatt hours. With energy at 10 cents per kilowatt hour its cost of operation is .10 × 32 = $3.20, to which the cost of the lamp $1.10 should be added, making its total cost $4.30.

The total cost of operation of the carbon lamp for 800 hours service is $4.41 ÷ 430 × 800 = $12.52, while that of the tungsten lamp is $4.30, or a saving of $8.22 effected by the tungsten lamp.

A more significant appreciation of the economy of tungsten lamps may be obtained by a study of the reduction in the expense of lighting a small factory employing seventy-five 25-watt tungsten lamps to replace the same number of 16 candle-power carbon lamps, the lamps being in service 27 days in the month for four hours per day. The service per month would thus be 108 hours. The initial cost of the tungsten lamps at $0.85 per lamp would be 75 × $0.85 or $63.75, for a life of 800 hours. Seventy-five 25-watt lamps have a total wattage of 1,875 and for 108 hours consume 1,875 × 108 ÷ 1,000 = 225 kilowatt hours. The cost for energy at 10 cents per kilowatt hour is $0.10 × 225 = $22.50. As the proportion of the cost of the tungsten lamps is $8.60 for 108 hours service the total monthly cost of lighting is $22.50 + $8.60 = $31.10.

The initial cost of seventy-five 16 candle-power lamps at 20 cents is $15.00, on a guaranteed life of 400 hours. For 108 hours service their cost would be $4.05. Their total wattage at 50 watts each would be 50 × 75 = 3,750 watts, and the monthly consumption of the lamps 450 kilowatt hours. Their cost of operation at $0.10 per kilowatt hour would be $0.10 × 450 = $45.00 to which the first cost for 108 hours, $4.05 must be added, making a total monthly cost of $45.00 + 4.05 = $49.05. Therefore the total monthly saving effected by substituting seventy-five 25-watt tungsten lamps for an equal number of 16 candle-power carbon lamps is $17.95, while the illuminating efficiency of the tungsten lamp equipment is 20 per cent better. Even if the carbon lamps were *supplied free* by the lighting company there would still be a saving in using tungsten lamps at their high first cost. The question of first cost is hence not a factor in considering the tungsten lamp.

Commercial Effect of the Introduction of the Tungsten Lamp.

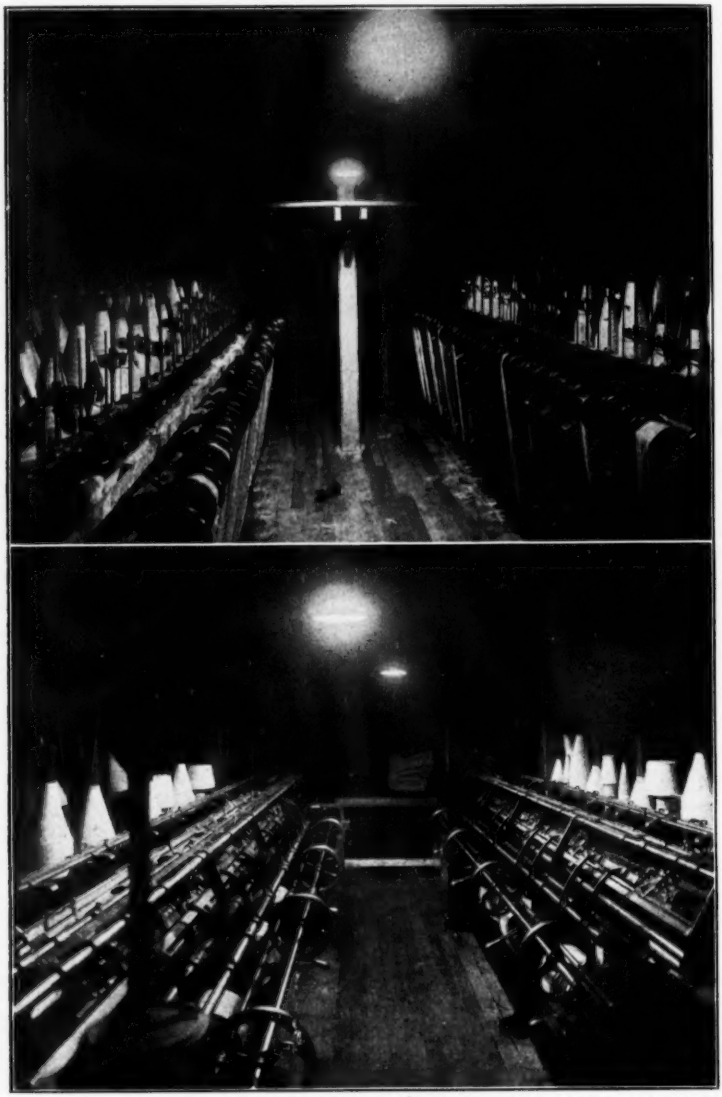
In determining the commercial effect of the introduction of the tungsten lamp, the existing as well as the possible users of electric light may be divided into three classes, depending on their probable relations to this new illuminant. The first class comprises customers who are now using electric lighting at what many be called the "maximum point," measured by the present standard of illumination, thus

MAZDA LAMP LIGHTING, CLOTH-PACKING ROOM.
Note the 40-watt lamps over the stock end of the table and 60-watt over the place where the packing is actually done.

reducing their watt-capacity and hence decreasing the revenue of the central station.

The following concrete examples may be mentioned of class one. In New York City the large retail tobacconists, the United Cigar Stores Company, has from its inception appreciated the tremendous advertising value of brilliantly lighted stores. Their recognition of electricity as the most effective means to this end caused them to expend $80,000 in the year 1907 for the electric lighting of their stores in Manhattan Borough alone. By employing the tungsten lamp they decreased this expense almost one-half, without sacrificing in the slightest their high standard of illumination.

In the second class are also present customers, but their utilization of current for lighting is below the maximum or "saturation point,"



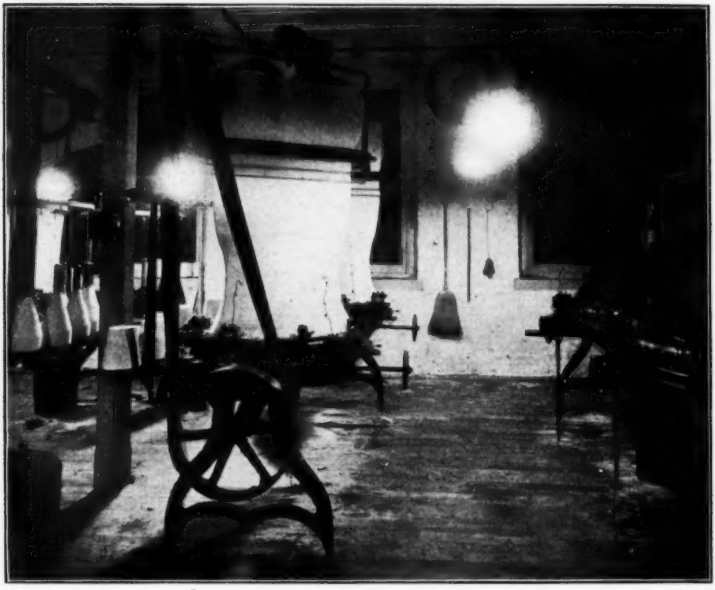
SKEIN WINDERS AND KNITTERS LIGHTED BY 60-WATT MAZDA LAMPS, ALL OTHER LIGHTS IN THE ROOM BEING TURNED OUT.

based on the present standard of illumination. Users of electric light in class two limit the amount of illumination chiefly on account of the expense involved. Central-station officials are now debating whether this class of customers will employ the tungsten lamp for the purpose of obtaining the same illumination for less money, or to obtain a greater amount of illumination for the same cost. Thus far the latter alternative seems the more popular.

INTERIOR OF KNITTING MILL, ARTIFICIALLY LIGHTED BY MAZDA LAMPS.

The more progressive of central-station officials are engaged in an active campaign among this class of customers pointing out the advantages which will be obtained from a greater amount of illumination, with a cheaper source of light. The recent appearance of multiple tungsten lamps of small candle power (20 candle-power on 25 watts) will undoubtedly prove a powerful factor in popularizing metallic-filament lamps for domestic or residence lighting.

In the third class of electric-light users are those who are at present utilizing some means of obtaining illumination other than electricity for economy's sake. It is obvious that the deficit from the loss of customers in classes one and two must be regained from class three, and at this writing the outlook augurs for not only a complete recov-



GROUP LIGHTING BY 60-WATT MAZDA LAMPS, SUGGESTING THE EFFECT ON COLOR ILLUMINATION.

ery of such loss, but also for a powerful impetus to the electric-lighting industry, due to the fact it is now able to secure a class of customers hitherto unobtainable.

Factors Which Have Retarded Rapid Introduction of Metallic-Filament Lamps.

The question which suggests itself to one after the discussion of the high efficiency and high intrinsic brillinacy of metallic-filament lamps is, why, if such lamps possess superior features to all types of incandescent lamps yet produced, has their introduction in the United States been relatively slow? The chief factor which has retarded the rapid adoption of the new lamps is the fact that American central-station customers are accustomed, in the majority of cases, to having their lamps supplied free. The relatively high cost of metallic-filament lamps requires a renewal charge which imposes a kind of inertia to their progress, and until the public appreciates the necessity of the central station in putting the new lamps on a different renewal basis from the carbon lamp, the metallic-filament lamp must struggle against this condition.

As is obvious, the new lamps must be advertised and the customers canvassed more thoroughly than is necessary where the consumer is in the habit of paying for his lamps, and hence more readily adopts and buys a new type of lamp instead of expecting the central station to supply him with lamps gratis.

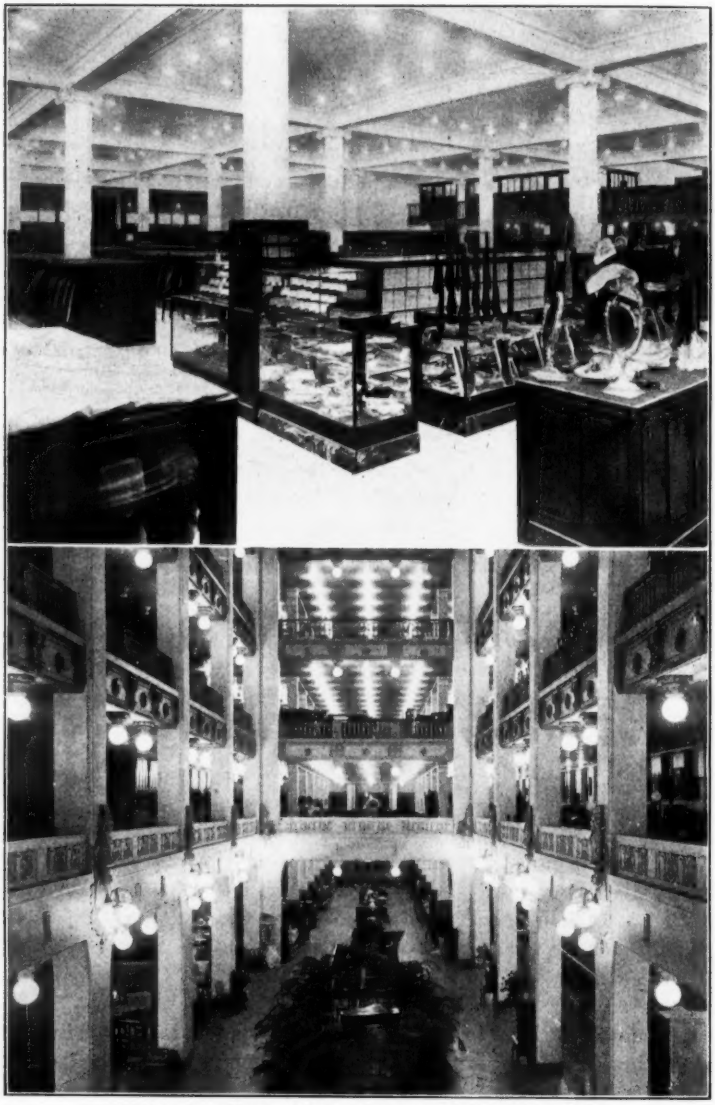
The present state of the metallic-filament lamp art and the existing commercial conditions with respect to the free renewal of incandescent lamps makes it difficult to determine the most satisfactory and desirable method of supplying tungsten lamps, but the consensus of opinion among central-station men would seem to indicate that the central-station gets the most desirable results by supplying the lamps on a monthly maintenance basis. It is left to the option of customers to buy their lamps outright and assume the risk of their breakage, or for a monthly charge the central station will undertake the supply and care of the lamps.

A fertile cause of the slowness (relative) with which the tungsten lamp has been introduced has been the necessity in most instances of changing the installation to suit the tungsten lamp, which in the units thus far supplied, give their best results when hanging in a pendant position with a single "Holophane" type reflector or enclosing globe around the lamp. Under many conditions this necessitates a rearrangement of installations requiring, as a rule, the buying of new fixtures and changes in the location of lamps, which things the customer strenuously objects to. Therefore the employment of metallic filament lamps is under most conditions a good deal more than the substitution of one kind of lamp for another, as it necessitates such changes as new shades or fixtures, or a new layout of the lighting in a scientific manner.

Principal Field of Service of the Tantalum Lamp.

The disadvantages of tantalum lamps—chiefly the high cost of tantalum—have been mentioned, from which it can be seen that this type of metallic-filament lamp has not met with the same degree of popularity as the tungsten lamp. The majority of the tungsten lamps used in America are of the 50-watt, 25-candle-power type and of the 40-watt, 20 candle-power ratings.

The tantalum lamp has met with the best success under conditions where the central station does not give free renewals of carbon lamps, as customers of such stations, being in the habit of buying their lamps, will more readily use tantalum lamps—which is true of all the metallic-filament lamps.



INTERIOR ILLUMINATION BY MAZDA INCANDESCENT LAMPS.
Courtesy of National Electric Lamp Association.

The majority of tantalum-lamp installations have been made in isolated plants. Its most satisfactory service has been accomplished in such plants in reducing the strain of overloaded machinery, and in affording increased illumination without increase of generating equipment. Unlike some of the other metallic-filament lamps, the tantalum lamp can withstand vibration and rough service and hence is very valuable for train lighting and in any service where shocks and jars would prohibit the use of the tungsten lamp.

PROPER INSTALLATION AND SHADING OF METALLIC FILAMENT LAMPS.

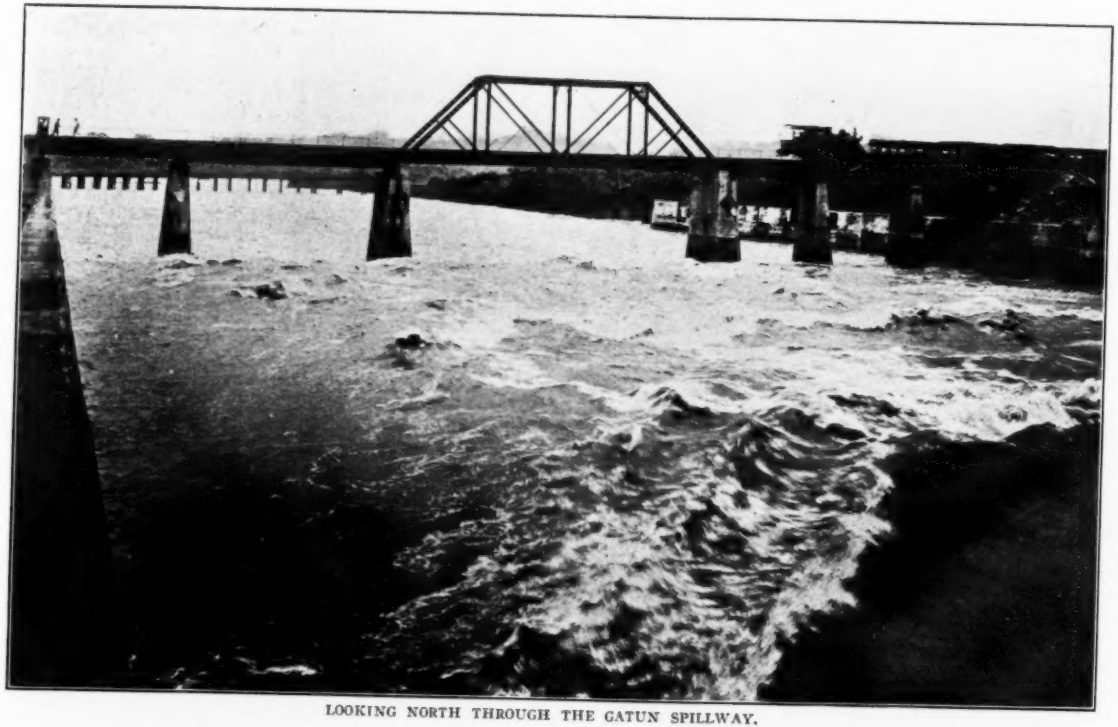
A frequent practice in installing ordinary carbon lamps with clear glass bulbs and without diffusing shades is to place them directly in the line of vision. Such practice with the new lamps of high intrinsic brilliancy is extremely dangerous as the money saved in light bills must be spent with the oculist if this precaution is disregarded.

Metallic-filament lamps should be installed well above the line of vision, or else be so shaded that their intrinsic brilliancy will be considerably reduced. Satisfactory results from such lamps can be obtained only by one or the other methods. The proper kind of shades for metallic-filament lamps is also important. The use of unsuitable fixtures for the new lamps will destroy nearly all of their improved illumination. The 40- and 100-watt tungsten lamps are frequently stuck in shades that merely form a fringe around the socket, or in shades in which they are entirely swallowed up. They are also burned in every conceivable position, which is dangerous to the life of the filament as explained.

The coming of 25-watt tungsten lamps demands additional precaution in burning and shading it properly.

The principal objections which are raised against the tungsten lamp are its fragility and high cost. These points are not without truth, although it is almost certain that improvements will in time eliminate both of these objections. The fragility of the lamp is not of serious consequence provided reasonable care is exercised in handling it.

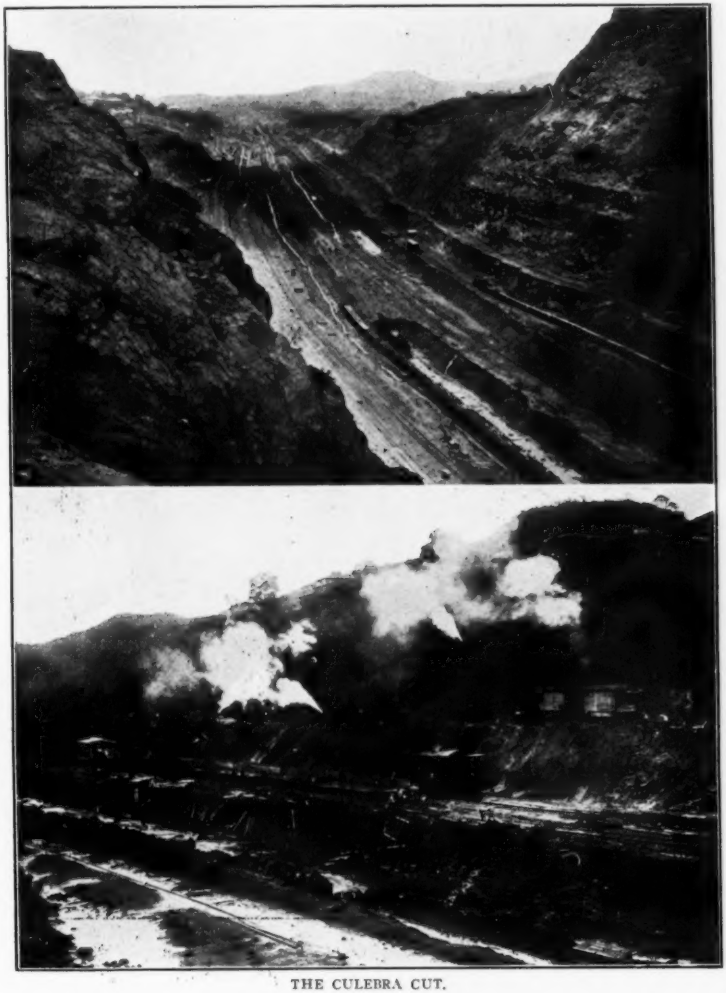
The problem of burning the lamp in other than a vertical position is somewhat more serious, although some manufacturers claim (and with truth) that their lamps may be burned in any position. The result from burning recent types of tungsten lamps, especially the 40- and 60-watt sizes, in various positions proved to the author that properly made tungsten lamps can be burned in almost any position, provided the angle with the vertical does not exceed about 45 degrees.



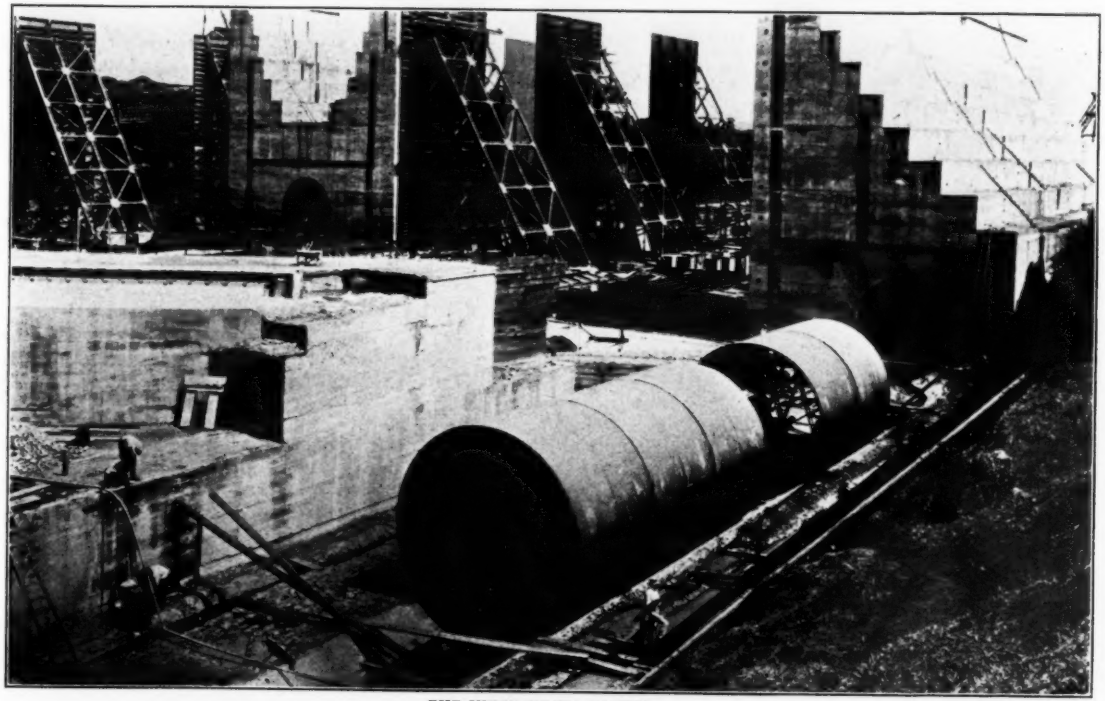
LOOKING NORTH THROUGH THE GATUN SPILLWAY.

PROGRESS IN THE CONSTRUCTION OF THE PANAMA CANAL.

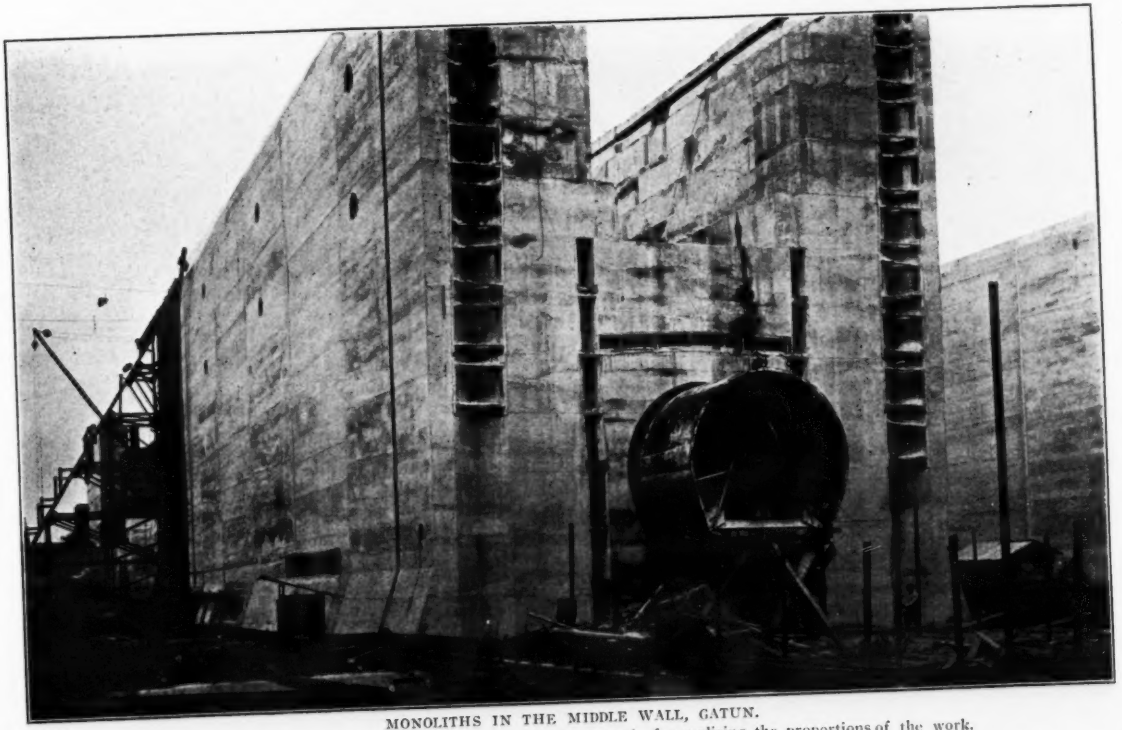
WITH ABSTRACT OF THE ANNUAL REPORT ON PAGE 427.



THE CULEBRA CUT.

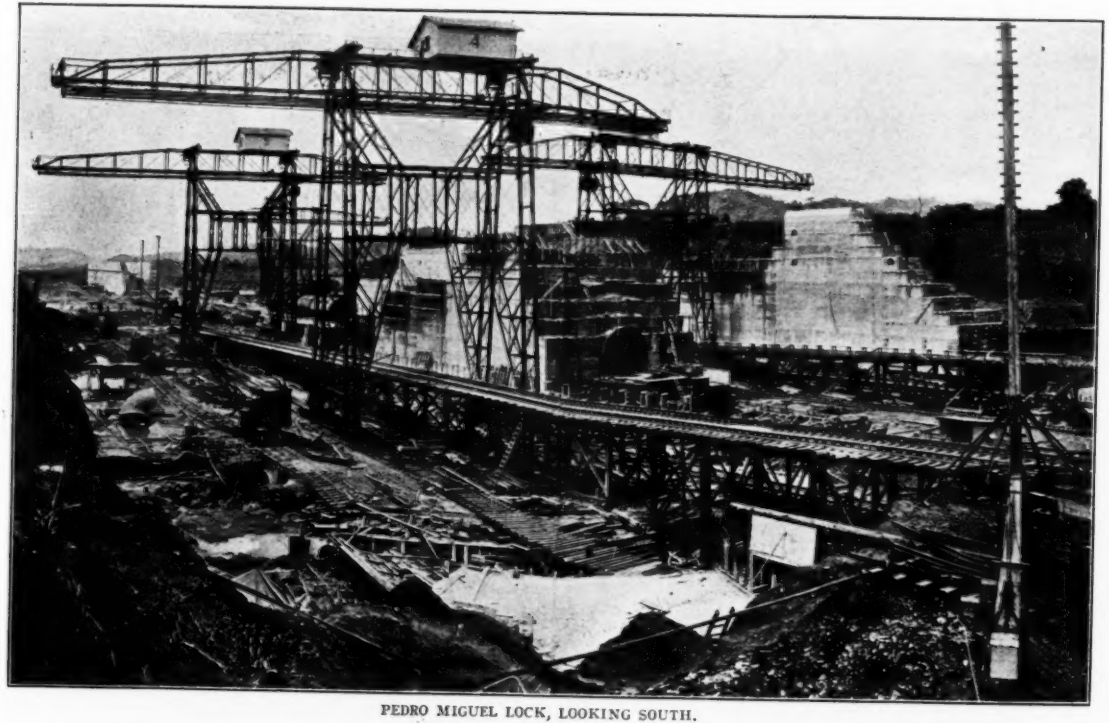


THE UPPER LOCKS, GATUN.



MONOLITHS IN THE MIDDLE WALL, GATUN.

The man in the right foreground affords an approximate scale for realizing the proportions of the work.



PEDRO MIGUEL LOCK, LOOKING SOUTH.

SYSTEMATIC FOUNDRY OPERATION AND FOUNDRY COSTS.

By C. E. Knoeppel.

III. THE PRINCIPAL ELEMENTS ENTERING INTO FOUNDRY ACCOUNTING AND MANAGEMENT.

In the article inaugurating this series, published in October last, Mr. Knoeppel outlined the elements of the foundry problem. His second paper discussed thoroughly the very important question of depreciation as its comprehension applies especially to the profitable conduct of a foundry business. He now takes up the remaining elements to be recognized in foundry organization and accounting and defines the character and limits of each.—THE EDITORS.

IN the preceding paper, the principal elements were briefly outlined, in order to make way for a discussion of "depreciation" of sufficient length to establish the connection between it and the elements pointed out. This paper will therefore continue the discussion as regards these elements, which were found to be—

1.—Commercial production.

2.—Maintenance.

3.—Construction—

A.—New construction.

B.—Reconstruction.

4.—Special work chargeable to customers.

5.—Expense.

COMMERCIAL PRODUCTION.—This element should comprise all castings made for sale to outside foundries, or to the company of which the foundry is a part, or to both, and should represent the *net good castings* produced in a period, with *no deductions made for whatever may be returned on account of error, defect, or other reasons.* In other words, the total castings produced in a period, less the bad castings of the same period, is the production. This may sound strange to a great many, but as I have found that the practice of several foundrymen has been to deduct from the current production whatever has been returned as defective, it seems advisable to outline what seems to be the correct procedure.

In the first place, what is produced is produced regardless of any outside consideration; and the rule should be that after castings are cleaned, carefully inspected, passed and shipped, they form a part of

the production and are subject to no deductions whatever for returns from the outside. In proof of this, let us assume that in a given period, 500,000 pounds or 250 tons of castings have been produced by the foundry, costing $12,500, and that the customers in the same period have returned 50,000 pounds of defective castings, which have been billed back at a price of $50.00 per ton or $1,250. Assuming that the market value of scrap is $15 per ton, these returned castings are worth $375 to the foundry, leaving a balance of $875 which the foundry must absorb. If we *increase* the cost and *decrease* the tonnage, the cost per ton is greater (on account of the decreased divisor) than it would be if we simply increased the cost and allowed the tonnage to remain as it stood.

The following figures will clearly show just what is meant—

A—Production reduced by returns—			
Cost of 250 tons		$12,500	
Cost of returns—			
Price	$1,250		
Scrap	375		
To expense		875	
Total cost		$13,375	
Cost per ton of the 225 tons (250-25)			$59.44
B—Production not affected by returns—			
Cost of the 250 tons		$12,500	
Cost of returns (see above)		875	
Total cost		$13,375	
Cost per ton of the 250 tons			53.50
Difference in cost per ton			$5.94

It is evident that if method "A" is incorrect but in use, the results are certainly going to be misleading, for no foundryman wants to use a cost of $59.44 in estimating if $53.50 is the correct figure. Assume that in the period during which 250 tons are produced, no sales are made. The castings are piled in the storeroom ready for delivery, when along comes the 25 tons of defective castings and as a result we proceed to adjust our figures so as to read 225 tons produced at a cost of $13,375 or $59.44 per ton. Should we decide to take an inventory on the first of succeeding period, we would naturally find that

we had 250 tons of castings on hand. Our book however, would show 225 tons of castings, and as their value according to the accounting is $59.44 per ton, we would naturally have to inventory 225 tons of castings at $59.44 per ton, making $13,375 and haul in 25 tons of castings from nowhere, at no value whatever—decidedly what the foundryman would not do. If, however, he inventoried 250 tons of castings at the rate $59.44, *the valuation would be $14,860 or $1,485 more than the production cost*—which would still be incorrect. If he had charged *25 tons of scrap* to the scrap account at $375 and $875 to his current producing cost and *left his production alone,* his result would be 250 tons at $53.50 per ton, making a valuation of $13,375. In case the practice in any particular foundry is to reduce current production figures by defectives returned, it should be discontinued as the above discussion should show its incorrectness.

We now come to a discussion of what should rightly be charged to the elements—Maintenance, New Construction and Reconstruction—a topic that has caused many a bitter argument, is confusing to many business enterprises, in addition to which we find that it is difficult for accountants to unite as regards a uniform or correct procedure.

Our first consideration is the fact that an expenditure of any kind either increases the value of what we may have and is therefore a charge to our assets, or it does not increase value in which case it is a charge against our revenue. Viewed in this light we can define Maintenance as—

All expenditure for work which simply *maintains,* without increasing in any way, the value of the plant, including all *repairs* and *renewals* to *real estate, buildings* and *equipment,* being the expense necessary to keep a thing in condition, operative, and useful.

The next element, New Construction, can be defined as follows—

All expenditures for work which *increases* (instead of maintaining) the value of the plant, such as *betterments, extensions* or *additions* to *real estate, buildings* and *equipment.*

The element Reconstruction can be defined as follows—

All expenditures for work which *neither increases nor maintains* the value of the plant, including any changing of what already exists which is not undertaken because it is absolutely necessary but voluntarily for some resultant advantage. To include also expenditures of an extraordinary nature, which may affect *maintenance.*

Maintenance would naturally be a charge against revenue; New Construction would be a charge to our assets while Reconstruction, neither maintaining nor increasing value, would also be a charge

against revenue. It might be well to state in this connection that expenditures for Reconstruction or Maintenance classed as Reconstruction, should not be entirely absorbed by the month in which they are made. Items that are chargable to Reconstruction are generally of an extraordinary nature and it is hardly fair to make any one month absorb the entire cost. This should be spread over a period of months to be decided upon according to the facts in the case. A later paper will take up the discussion of the accounting features in connection with Maintenance, New Construction and Reconstruction.

It would appear as if the matter of correct charging would not be difficult but the task becomes complicated in the absence of a well defined way of handling the various cases as they come up, so that the problem of next importance is to outline if possible some procedure as regards a dividing line between charges to our assets and charges against revenue, in which respect misconception has done no end of harm to industrial undertakings, as a great many know—to their sorrow.

One manager whose whole aim and purpose is to *keep cost down,* will oftentimes allow this desire to get the better of his judgment and as a result items which should be charged against revenue are classified as assets. Another manager, desirous of getting at the *true showing, regardless of the effect,* will make revenue stand such items as are a legitimate charge against it. In other cases what one manager considers a charge against revenue, another will feel perfectly justified in treating as an asset. It therefore seems as if the deciding factor as regards questions affecting assets and revenue, in many instances is either personal opinion or the desire of the executive, rather than an effort to outline a uniform policy; consequently it is but natural that we should find so many different methods in practice.

Assets in the strictest acceptance of the term, should mean one of two things:

1.—Money on hand or its equivalent.

2.—That which can be converted into money.

This establishes the fact that assets are of two kinds, *quick* and *fixed.* Cash in bank and accounts receivable would come under the first class, while real estate, buildings, and equipment would be classed as fixed assets. If this is a correct interpretation of what assets are, there is no excuse for railroading into the assets accounts items which cannot pass this conversion test; for an item does not add a cent's worth of value to the plant, if the amount expended cannot be converted back into money. This test can be reduced to a more practical basis in a great many instances by the question: "Can I dispose of it

for the money I have expended?" The answer to this, if the attempt to get at the truth is a conscientious one, will determine how the charge is to be made.

The question whether asset values should be considered from the standpoint of the "going concern" or the "forced sale" is entitled to some consideration. I well remember attending a forced sale of a plant which brought less than $10,000 under the hammer, although the assets were appraised at nearly $100,000. Investigation developed the fact that the plant was old and run down; no provision had ever been made for depreciation; the management had been of the "guess-work" kind and the appraisers had valued each item at the cost to replace it, consequently the assets were all out of proportion to their true value, although $10,000 was less than what the plant may have been worth.

It makes a remarkable difference in the amount that can be realized, whether a concern does not particularly care whether it sells or not or whether it is forced to sell. In the first case it can demand, and no doubt secure, a much larger figure than would be the case if the creditors took a hand. With the forced sale we find conditions that can be classed as unnatural. The buyers pay little attention to correct values—they are out for *bargains,* knowing full well that the consideration of prime importance to the creditors, first, last and all the time is—*the settlement.*

A doctor asks a certain fee for an operation, a fee on a par with that asked by other doctors. The fact that a prospective patient refuses to pay this fee is no evidence that the services are not worth what was asked for them, for he will find plenty of patients, if he is successful, who are willing to pay the regular amount. If the doctor is "up against it," he may consent to take the case for much less than the regular price; but this does not by any means represent the true value of surgical services, although as far as the doctor himself is concerned his condition forces his value down and that is as far as the influence can be made to go. My neighbor buys a piano for $600, has it a year but uses it very little. His wife dies and he decides to sell out everything. I want the piano and as we have been firm friends, he consents to sell it to me for $200. That he sold it to me for this figure is no indication that it is worth only $200, for I could no doubt get nearly as much as was originally paid for it. Friendship and a desire for a quick sale, regardless of value, were the underlying motives contributing to the decline in value to $200—a false value, as everyone can appreciate. So with the forced sale—the values are false and should not be considered as a guide in arriving at an asset value.

If an item is useful and necessary; if it facilitates production or is a business getter; if it is something that can no doubt be used to advantage by a prospective buyer, it is something of value and can be added to our assets; for it is safe to assume that it would find a buyer at the price asked. If any doubt exists, however, its cost should be absorbed by revenue—a safe and sane procedure—keeping out of the assets questionable values, which if included tend only to mislead, oftentimes with results not at all gratifying.

After all, the main thing to consider is that as long as "cost of production" is to absorb everything, it is playing safe to write all doubtful cases into cost; and if, in addition to this, the attempt to have the cost absorb items that can be rightly considered as assets is an honest one, the values will not be far off.

Definitions and a general outline as to procedure are sometimes easy to understand, but when we come to deal with specific cases we may find that the proper handling is still rather difficult on account of the various ways of looking at the subject. I know of one concern making a standard type of machine which for years has been in successful competition with other makes, where the policy is to charge all patterns and drawings on all new work to the expense account in the month in which they are made. In another concern where the designs have been constantly changing, patterns and drawings have been charged to assets, subject to a ridiculously low depreciation rate, and as a result both accounts are way in excess of what they should be. Both ways cannot be right; in fact both may be wrong, for which reason it seems advisable to get down to a discussion of cases.

Case 1.—Making New Wood Flasks.

A.—Stock size, for general use and not replacing old or discarded flasks—

This transaction can hardly be considered as in any way increasing value, first because of the short life of wood flasks, and second because the usual foundry wood-flask equipment is about ready to be used for firewood, and from the standpoint of a convertable security is worth next to nothing. Wood flasks are constantly wearing out, new ones being added to take their places. If they vary much as to size, is this sufficient grounds to class them as assets? Would it not be better to consider them as maintaining the value of the wood-flask equipment, which if entered as assets should be represented by a nominal figure to cover the whole equipment, subject to change only as the business

expands. It would seem from the above that the case should be classed as a Maintenance item.

B.—For a special line of work—

It follows that it is the special work that makes this flask making necessary. Value has not been increased, because the flasks will no doubt be useless when the special work has been done. Nor has value been maintained according to our definition, consequently this charge should be considered as expense and absorbed by the special work to be made in them.

C.—To replace old and worn out flasks—

1.—If stock size for regular use, the expenditure would be a Maintenance item as it does not increase value to any extent, simply maintains it.

2.—If for special work, it would be a charge against the work the same as 1B.

Case 2.—Making New Iron Flasks.

A.—Standard sizes for general use and not replacing old or discarded flasks—

Iron flasks under the condition outlined no doubt increase value. They are necessary and useful; they facilitate production and are something a prospective buyer could use to advantage, and as they possess a much greater degree of permanency than wood flasks, we can safely class them as a New Construction item.

B.—For a special line of work—

Remarks at 1B would apply if the flasks would be of little value after the special work was made in them. Should they be so designed, however, as not only to take care of the special work but to be useful for general purposes, then it would be well to charge part of the cost against the special work and the balance to New Construction.

C.—To replace old and worn out flasks—

Remarks at 1C would apply here.

Note.—Care must be exercised in determining whether a new flask is a replacement, or for special work, or an addition to the existing equipment. The proposition is usually a confusing one for there have been cases where new flasks have been made as a replacement but put in as new equipment, because the flask was *new* and also because the fact that the ones they replaced had been lost sight of. If not rightly looked after, the proposition will soon become hopelessly confused.

CASE 3.—MAKING A LOT OF WOOD FLASKS, WITH IRON BARS, WHICH ON ACCOUNT OF THEIR CONSTRUCTION WILL LAST A REASONABLE LENGTH OF TIME.

The procedure outlined for 2 ABC seems upon consideration to take care of this case also, although the life of such flasks would be shorter than iron flasks.

CASE 4.—A NEW BELT TO REPLACE AN OLD ONE.

As this belt was added to keep the transmission equipment in good running order, it would have to be considered a Maintenance item, according to our defintion.

CASE 5.—A NEW BELT PLACED ON A NEWLY INSTALLED MACHINE.

The new machine adds value, and being a security that can be converted into money, is an asset. The belt being a component part of this machine along with the countershaft would naturally be included in the cost of the installation and also considered an asset, consequently a New Construction item.

CASE 6.—CHANGING THE LOCATION OF A DEPARTMENT.

A move of this kind neither adds value nor maintains it—as we would have just as much value after the change as before; consequently, the cost of the work would be chargeable to Reconstruction and absorbed by expense.

CASE 7.—CHANGING THE LOCATION OF DEPARTMENT AND ADDING A NEW DEPARTMENT.

As consideration will show, we have a transaction of which part neither adds nor maintains value and part adds value; hence it affects both Reconstruction and New Construction, the cost of the changing and the addition to be kept separate for correct charging.

CASE 8.—PAINTING THE BUILDINGS AND WHITEWASHING THE INTERIOR.

In this instance the work is done to maintain value, but as the expense is of an extraordinary nature it would be hardly fair to charge the cost against the month in which the work is done, for which reason it should be classed as a Reconstruction item and the cost spread over a period of months, to be decided upon as being just and equitable, Reconstruction to be credited and Maintenance charged with the monthly portions.

CASE 9.—TAKING DOWN A LINE SHAFT AND PLACING IT IN ANOTHER POSITION.

See Case 6.

CASE 10.—EXTENDING LINE SHAFT FOR AN EXTRA PULLEY AND BELT.

Here we have another instance of adding something which would pass our conversion test, consequently we can class this as a New Construction item.

CASE 11.—RELOCATING MACHINERY, WITH THE VIEW TO IMPROVING THE EQUIPMENT FACILITIES, MAKING NO CHANGES IN TRANSMISSION ARRANGEMENTS EXCEPTING WHERE NECESSARY TO CONNECT THE DRIVES PROPERLY.

In this case we move what is already considered as something of value, from one place to another, and add what may be necessary to effect proper transmission; but as it is more than likely that what was added replaced worn out parts, it is proper to treat this case as effecting Reconstruction.

Should it happen that quite a little new material had to be added *as an addition,* not a replacement, it being necessary to discard some of the equipment previously used, then the case should be handled by charging Reconstruction for the relocating and New Constructions for the additions, crediting the latter for the present value of this discarded material.

CASE 12.—RELOCATING MACHINERY, PUTTING ON ALL NEW BELTS.

Here we have a transaction effecting both Reconstruction and Maintenance for as regards the relocation, we neither add nor maintain value, while replacing belts would be a move to maintain value. To save needless accounting however, the whole cost should be charged against Reconstruction and spread over a period of months.

CASE 13.—RELOCATING MACHINERY, INSTALLING MOTOR DRIVES TO REPLACE BELT DRIVES.

In this case we can see that Reconstruction is effected for the cost of the relocating but that we have also added something of value in the way of new motors, consequently for the latter we would charge New Construction and credit it with the present value of the belts.

CASE 14.—INSTALLING A PRODUCER-GAS PLANT TO REPLACE A STEAM EQUIPMENT.

This is of course a replacement, but not made to maintain value nor in the sense that we relocate a department or machine. We elimi-

nate something of value and add something of value. The difference in values must be considered, which gives rise to the query regarding which of the following values should be used—

1.—The difference between the present value of the steam equipment and the cost of the gas plant.

2.—The difference between what we are allowed for the steam plant and the cost of the gas plant.

3.—The difference between what we pay for the gas plant and what we sell the steam plant for.

The steam plant was put in the assets, when new, at a certain figure. It now has a value, less than the original amount by what has been absorbed by cost of production; consequently the balance remains to be returned to the business. We cannot leave this amount in our assets because we do not have this value in any convertible security; consequently we should charge New Construction for the cost of the gas plant—charging "Values Adjustment Account" and crediting Assets for the present value of the steam plant. What we are allowed in exchange or receive for selling the steam plant would be a credit to "Values Adjustment Account."

CASE 15.—EXTENDING THE CRANE RUNWAY AND REPAIRING THE REGULAR RUNWAY AT THE SAME TIME.

This transaction will be seen upon consideration to involve New Construction for the value of the extension, and Maintenance for the repairs on the regular runway. Value is increased on the one hand and maintained on the other.

CASE 16.—REPLACING THE EQUIPMENT OF METAL PINIONS WITH RAWHIDE PINIONS AND IN CERTAIN PLACES SUBSTITUTING STEEL GEARS FOR IRON GEARS.

As the cost of the work originally placing these gears and pinions in position was absorbed by assets, the work replacing them neither maintains nor increases value consequently it involves Reconstruction. The cost of the new material less the present value of the discarded pinions and gears is a just charge to New Construction.

CASE 17.—REWIRING THE PLANT; REPAIRING WHAT DOES NOT NEED REPLACING; CONCEALING THE WIRES; SUBSTITUTING TUNGSTENS FOR THE INCANDESCENTS AND FLAMING ARCS FOR THE ORDINARY ARCS IN USE, AT THE SAME TIME WIRING UP A NEW DEPARTMENT JUST CONSTRUCTED.

This case is rather a confused proposition, involivng New Construction, Reconstruction and Maintenance, as we add value, maintain

value and do neither. Extreme accuracy would be possible but impracticable. The procedure would seem to be: charge Reconstruction with all of the cost of the work, less the work in the new department which would be a charge to New Construction, and increase the assets by the difference in values between the tungstens and flaming arcs and the lamps discarded.

CASE 18.—PUTTING IN A NEW CUPOLA SHELL TO REPLACE ONE WORN OUT; ADDING TWO OR THREE EXTRA COURSES TO THE STACK; INCREASING THE NUMBER OF BLAST CONNECTIONS AND RELINING THE CUPOLA.

We can outline the procedure for this case as follows—

Putting in new shell.	To Maintenance on account of value being maintained.
Relining cupolas.	
Adding extra courses.	To New Construction on account of value being added.
Increasing connections.	

the cost of the work less the value of the new items to be charged to Reconstruction on account of the work being of an extraordinary nature, and spread over a period of months.

CASE 19.—THROWING OUT A MOULDING MACHINE WHICH HAS NOT MEASURED UP TO THE EXPECTATIONS AND INSTALLING A BETTER TYPE.

While adding something of value, we are also losing something of value. To handle this transaction properly so as to produce a true showing, the procedure should be along the same lines outlined in Case 14.

CASE 20.—MAKING NEW PATTERNS AND DRAWINGS.

A.—For an improved type of a standard machine.
B.—To suit the wish of a customer.
C.—To correct a fault existing in the design of a machine.
D.—For a new and untried type of machine.
E.—For maintenance of equipment.
F.—For new equipment.

The correct handling of the cost of patterns and drawings has always been a source of considerable discussion. A statement showing "net worth" which included all patterns and drawings would be open to question; in fact, an executive in favor of charging his own patterns and drawings to assets would be the last men to sanction the

purchase of another concern without first satisfying himself that he was not going to pay for patterns and drawings that were of little value to his business, which gives rise to the query: what patterns and drawings are of value to a business?

In one sense it is doubtful if any are. New manufacturing processes, new tools, better designs, the failure of designs to be a commercial success, and numerous other reasons, all contribute to make patterns and drawing a doubtful quantity as regards their value. Uncertainty is another factor. What might be considered an asset may prove a failure, and on the other hand what was considered problematical and not regarded as an asset may prove to be a great success. It seems therefore as if no definite method of procedure can be outlined. If, however, the viewpoint is not so much the desire to get as much as possible into the assets as it is to make production absorb capital charges, it makes it unnecessary to "split hairs" in deciding just how to proceed. If the cost is absorbed at once, revenue takes care of what would otherwise be a capital investment—the safest way. If the cost is considered an asset and spread over a period of years, capital investment is returned slowly (in one case I know of, 3 per cent annually on decreasing balances is considered a correct pattern and drawing depreciation) sometimes much more slowly than the corresponding discarding of patterns and drawings—a procedure that assesses each year, after a certain period, with an unjust cost.

Getting back to the case outlined, a procedure might be outlined as follows:

20A.—As the type of machine is standard and the improvement made only after it has been demonstrated that it will make the design more efficient, it is safe to consider this an asset. The estimated life of the design, however, should not be placed at a figure which is equivalent to saying that it will never be declared obsolete. It must be remembered, as pointed out in the preceding paper, that the whole aim and purpose of a depreciation allowance is to have production refund capital investment, and the more quickly it is returned, the better.

20B.—This is obviously a charge against the contract, as it is the customer's wish which makes the change necessary. He may or not be willing to pay for this change, but this does not alter the fact that value is not increased nor is it maintained.

20C.—If a fault exists in the design, it means that the security is not as valuable as it should be; consequently to make it valuable to

the trade (which is only another way of saying that it is of value to us) we must expend enough to make it so—hence the item is a charge against revenue.

20D.—Here we have an element of chance. It is possible that the type will be a success—it is just as likely however, to be a failure. We do not know as yet whether we have anything of value of not; consequently it is not playing safe to call it convertible security, if it is not known that such is or will be the case. The safest plan is therefore to make the current year stand the expense, one-twelfth per month, if the expense exceeds a figure decided upon, or the current month if the cost is a small one.

20E. and F.—The cost of patterns and drawings for new equipment would naturally be a New Construction item, while if for Maintenance, revenue would have to absorb it.

THE ECONOMY OF SMOKE PREVENTION.

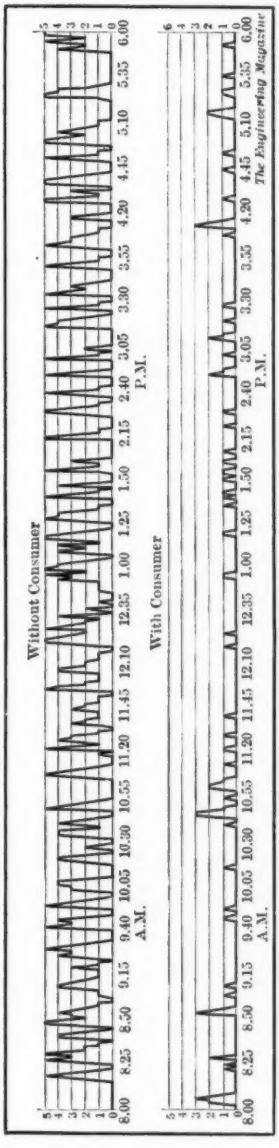
By J. A. Switzer.

Professor Switzer's paper is of special interest because it offers exact, quantitative testimony from an unbiased source on an often disputed point—the possible effectiveness and the operating cost of proper steam-jet devices for the boiler furnace.—THE EDITORS.

THE dream of a smokeless city, however desirable its realization may be, would, I fear, remain but a Utopian dream were it not for the saving fact that smoke prevention is waste prevention. Show a manufacturer that by ceasing to contribute his quota to the city's smoke he can make an appreciable saving on his own coal bill, and he will give you a respectful hearing. Smoke prevention in the future is to be attained, doubtless, by the installation of boiler plants properly designed to carry on smokeless combustion, and strict prohibition of the erection of any other kind; but those of us who are alive today are interested in the immediate abatement, or at least the immediate amelioration, of the smoke nuisance.

Among the present-day types of boiler and boiler setting the worst offender is the ordinary return-tubular boiler set directly over and quite close to the grates, and fired with bituminous coal. It is, too, the most prevalent. What hope is there for this type of plant?

Hope there certainly is. There are now on the market some half-dozen designs of so-called "smoke consumers," (more properly designated as smoke preventers) all operating on essentially the same principle; that of injecting an adequate supply of heated air into the combustion chamber whenever by reason of adding fresh fuel the increased air supply in needed. This is accomplished by the use of steam jets, automatically controlled. The makers of these devices are, of course, not slow to lay claim to large economies resulting from the use of their apparatus. And their claims are seemingly upheld by the publication of boiler trials made "before and after taking." An evaporation of so-and-so many pounds of water is increased by the "consumer" to so-and-so many pounds. But none of these reports, so far as I know, includes any statement of what part of the increased evaporation is utilized in merely operating the jets themselves. One is left to infer the amount is quite negligible.



SMOKE CHARTS OF THE TRIAL RUNS WITH AND WITHOUT STEAM-JETS.

With the particular aim of determining this point, a test of one of these devices was recently made under my direction by students at the University of Tennessee. The device consists of four steam jets passing through the boiler front and discharging into the combustion chamber directly over the fire-doors; a valve in the steam line supplying the jets is so connected to the fire-doors as to be opened whenever either fire-door is opened, and connected also to a dash-pot arrangement by means of which the valve closes slowly and only after a predetermined period following the closing of the fire-door; there is also a damper upon each fire-door, which also is connected to the dash-pot arrangement in such a manner that when the fire-door is closed the dampers remain open for a few minutes (thus providing an avenue for the inspiration of air) and then slowly close coincidentally as the steam supply to the jets is slowly diminished.

The test of this device consisted of two 10-hour trials of the boiler conducted on successive days with conditions as nearly alike as possible, save that on the second day the smoke preventer was in operation, but not on the first day. The trials were carried through in accordance with the code, and attention was given to every least detail of a regular boiler trial. Smoke observations were made and charts plotted on the Ringelmann scale. A close study of

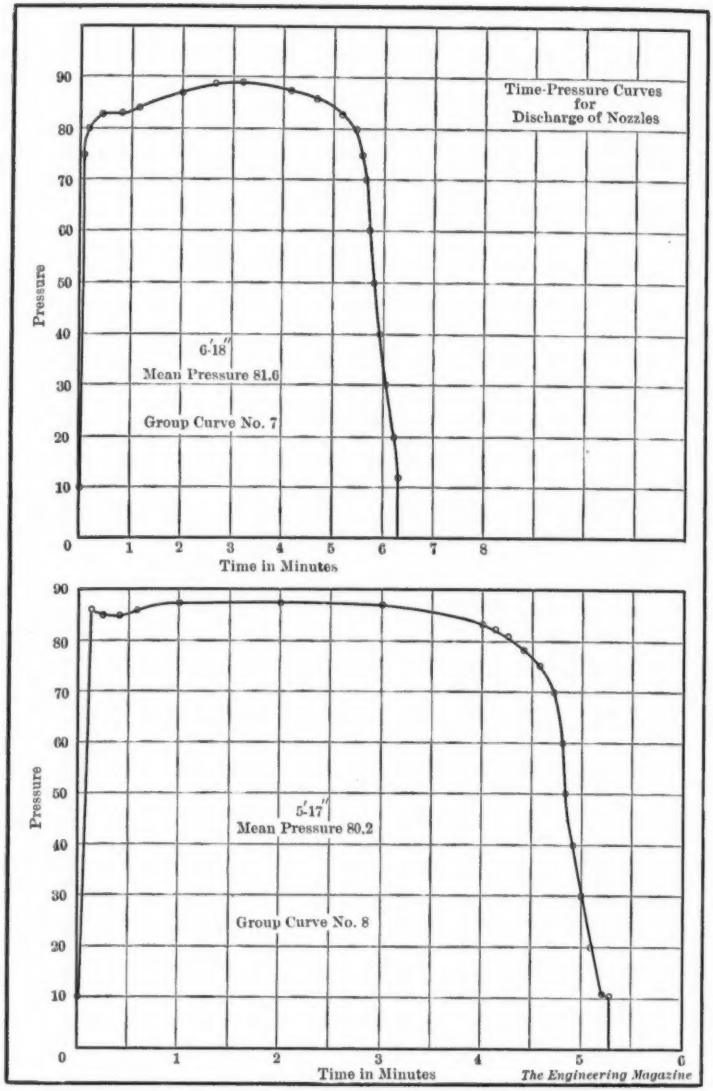


FIG. I. CLOSING CURVES OF STEAM-JET APPARATUS.

the smoke charts is not required to demonstrate that the preventer really does prevent the formation of objectionable smoke. It should be remarked that on the occasion of both trials the stoking was done with intelligence, and equally so for both trials.

In order to determine precisely the quantity of steam passing through the jets of the preventer during the second boiler trial, rather an elaborate set of observations was necessitated. A standard test steam gauge had been placed on the pipe supplying steam to the jets. In front of this an observer was stationed, stop-watch in hand. Each time that one of the fire-doors was opened either for stoking or for any other purpose, the watch was started and as rapidly as he could the observer recorded the steam pressure on the jets and the elapsed time. A period varying from 10 to 30 seconds was found to be required for the pressure to attain its maximum. It remained at its maximum for a longer or shorter period, depending upon the promptness with which the fire-door was closed. Following the closing of the fire-door, the slow operation of the dash-pot throttled the steam down slowly to its minimum pressure. The time required for this part of the operation was not uniform, owing possibly to some lack of nice adjustment of the dash-pot arrangement. The observations with the stop-watch were not concluded until the steam pressure had reached its minimum value, at which it was intentionally maintained between times. For each of these sets of operations (of which there were 41 during the 10 hours) a curve was plotted between time as abscissa and pressure as ordinate. Figure 1 shows two typical plottings. We call these the "closing curves," and in order to interpret them into pounds of steam consumed, a calibration test of the jets was made. To accomplish this the steam pipe carrying the nozzles was turned from its operative position across the front of the boiler setting to one in which the nozzles could discharge into a surface condenser of special design. With this arrangement perfected, the calibration test was run. Twelve sets of observations constituted the run; for each set the steam pressure was maintained constant and the discharge rate measured. The observations ranged from the full boiler pressure as a maximum to the minimum pressure utilized during operation of the device. Figure 2 is the calibration curve, plotted between pressure as abscissa and discharge in pounds of steam per second as ordinate.

Now by means of a planimeter the mean ordinate of each closing curve was determined, and from the calibration curve the corresponding discharge rate was read off. This discharge rate being assumed to

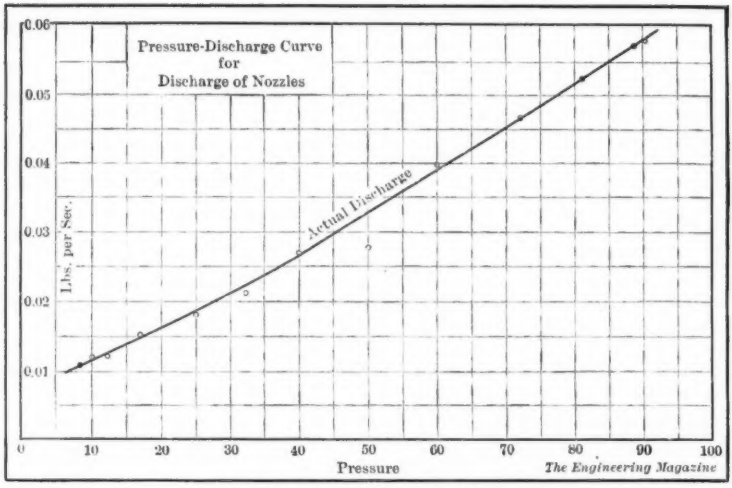


FIG. 2. CALIBRATION CURVE.

be the average rate for the particular closing curve, the total discharge is obtained by multiplying the rate by the duration of the operation. To carry this process of calculation through for the 41 operations was deemed unnecessarily laborious, inasmuch as the operations easily fell into groups of closely similar performances. Accordingly it was found that nine such groups could be formed and thus simplify the calculations without sacrifice of accuracy.

The calculations of discharge are tabulated below:

TABLE OF CALCULATIONS OF DISCHARGE.

Pressure Curve No.	Mean Pressure From Mean Ordinate.	Steam Discharge Per Sec. From Curve.	No. of Operations Per Group.	No. of Seconds Per Group.	Total Steam Per Group.
1	84.8	.0545	7	3,872	211.0
2	69.4	.0447	3	1,569	74.8
3	84.2	.0541	1	1,180	63.8
4	79.8	.0514	4	2,243	115.3
5	81.0	.0521	10	5,060	264.0
6	79.2	.0509	3	1,377	70.1
7	81.6	.0525	4	1,580	83.0
8	80.2	.0516	6	1,884	97.2
9	78.6	.0503	3	680	34.4
Totals			41	19,579	1,014.5

This table takes into account only the time during which the consumer was open.

No. of seconds closed	=	16,421
At 7 pounds pressure, discharging per second	=	0.0115 pounds
Total discharge	=	188.8 pounds
Grand total for 10 hours	=	1,203.3 pounds
Per cent of total steam used by consumer	=	4.6 per cent

With this figure determined, a comparison of the two boiler performances becomes very interesting; and in order to facilitate the comparison, the principal data are shown in parallel columns:

Size of boiler, builder's rating, 75 horse-power.
Kind of coal, bituminous.

		1st Trial.	2nd Trial.
Heat value of coal	B. t. u. per lb.	13,592	13,374
Total coal consumed	Pounds	2,850	3,200
Total combustible	"	2,270	2,757
Per cent. CO_2 in flue gas	Per cent.	11.2	11.0
Draft gauge near damper	Inches, water.	.093	.119
Steam pressure	Pounds	96	96
Temperature, flue gas	F. degrees	313	217
" feed water	"	137	133
Total feed water	Pounds	19,007	25,821
Actual evaporation per pound dry coal	"	6.7	8.0
" useful evaporation per pound dry coal	"	6.7	7.7
Equivalent evaporation per pound dry coal from and at 212 degrees	"	7.4	9.0
Equivalent useful evaporation per pound dry coal from and at 212 degrees	"	7.4	8.6
Equivalent evaporation per pound combustible, from and at 212 degrees	"	9.0	10.4
Equivalent useful evaporation per pound combustible, from and at 212 degrees	"	9.0	9.8
Horsepower (useful) on basis 34½ pounds equivalent evaporation	"	59.5	79.0
Efficiency of the plant	Per cent	52.6	62.1

Owing to the fact that the load upon the boiler was not the same for both trials, the increase in economy cannot be wholly attributed to the use of the automatic jets, although doubtless the major part of the increase should be credited to this source. The difference in loading serves, however, to emphasize the effectiveness of the device in preventing smoke; for while without its use the boiler cannot be driven up to 80 per cent of its rated capacity without producing dense black smoke, the use of the jets permitted the boiler to carry 105 per cent of its rated capacity with entire absence of objectionable smoke.

Hence the demonstration is made not only that smoke prevention even with the worst type of high-pressure steam boiler is possible, but also that its prevention is a measure of no little economy.

Armed with proofs of such potency as this, the advocates of smoke prevention should push their campaign for an unpolluted atmosphere with unflagging presistence. The arguments are all on their side: arrayed against them are no considerations of even selfish interest—nothing, indeed, except a stolid ignorance, blind alike to self-interest and to the rights of the community.

THE TWELVE PRINCIPLES OF EFFICIENCY.

By Harrington Emerson.

VII. THE FIFTH PRINCIPLE: THE FAIR DEAL.

"We have progressed so rapidly in material prosperity that we have lost our heart and our humanity."—W. L. Ward.

"Either side gets just what it grabs. Hence if I were a workman I would go back into the union and fight fiercely for a high, straight wage and eight hours and if I were an employer I would battle for straight piece work. To my mind the matter of justice is chimerical bosh. Either side will get just what it has power to take. It is the law, the fight of life. The mechanical industrial army is now to America what the Prætorian Guard was to the Roman Empire—at once the support and menace to the country.

"For this reason I helplessly turn to the sole recourse of laughing at the individuals who become flushed in their earnestness over the details of the struggle. Nevertheless I think great work was done on the Santa Fe—no one better than myself knows the obstacles to overcome in order to make your plan work. It seems to have smoothed down in a masterful manner the plumage ruffled by the antecedent strike. While I do not personally believe in the protestation of a desire for fair play, you seem to have convinced notable representatives of both sides of the plausibility of an impossibility."—Extract from letter written July, 1907, by the associate editor of "the oldest journal and the leading journal of its kind, published at the greatest railway center in the world."

We have ventured to place the extract above in immediate juxtaposition to Ward's dictum, because it is a specific definition of the mental attitude of the employing class which is the most serious obstacle in the way to a better, a more efficient, order. It formulates the doctrines to which the Twelve Principles of Efficiency are an earnest gospel of dissent.—THE EDITORS.

THIRTY years ago there was a deep-worn trail leading from the plains of Texas to the forks of the Platte, a distance of 800 miles. This trail I could recognize by its furrowed hollows if I drove across it in darkest night. Long-horned, wild-eyed, cat-hammed Texas steers, half a million in a season's drive, slowly grazed northwards, bringing Texas fever with them. The heifers were retained in Texas to become the dams of other inferior long-horns. All this is changed. Short-horn, Hereford, Galloway bulls have resulted in graded short-horn, well rounded, well mannered progeny which travels north in palace stock cars and there is strict quarantine against Texas fever.

The best basis for peace, for harmony, for high performance, is selection of the human thoroughbreds, exclusion of the undesirable human Texas long-horns.

It is in this manner that our future officers, military and naval, are recruited. Having been carefully selected they are given the fair deal. During good behavior they remain; their promotion is sure although slow, their position is high, they are welcome guests in society and at the most exclusive clubs.

Should the practices based on several thousand years of experience not be taken to heart by industrial organizers?

The captain of a whaler recruits his motley crew by fraud and violence and rules them with the discipline of the Old Testament: eye for eye, tooth for tooth, hand for hand, foot for foot, burning for burning, wound for wound, stripe for stripe, *lex talionis* in all its hideousness. He who recruits his shop with scarcely more discrimination, who does not even attempt to find out whether the young applicant is suited mentally and physically for what is to be a life work, who does not attempt to find out whether the itinerant applicant is morally and industrially a fit associate for the other men, an acquisition or a detriment—a near-organizer of this kind must necessarily rely on foremen as arbitrary and undisciplined as himself, must necessarily rely on physical rather than on moral suasion.

The name of Leonidas has thundered down the ages.

When Xerxes invaded Greece with an army of a million men recruited from forty-six nations—almost as many nations as are represented in the great Pittsburg shops—he offered Leonidas the kingship of all Greece, but from the quarreling Greek contingents the King of Sparta selected only 8,000 men. When the pass of Thermopylae was turned through the treachery of a Greek, Leonidas excluded and sent away all his allies except 700 Thespians, and with these and his 300 Spartans remained to do battle as long as one remained alive. The more select the force the greater its efficiency.

When we see ill mannered children we blame the parents, not the children; and on the dreadful Yukon winter trail in 1900 some men maltreated and maimed their unruly dogs until the Northwest mounted police had to interfere, but more carefully selected dogs, showing all the eager soul that Maeterlinck imputes to them, came joyfully jumping around their better master, ready to die at his bidding.

The fair deal, based on the exclusion of the many, the selection of the few, must primarily spring from the master, not from the man. "With what measure the employer metes it shall be measured to him

again, therefore all things whatsoever ye would that men should do to you, do ye even so to them." But mere kindliness of heart, mere desire to be fair, does not accomplish anything. Most boys would be better off in a severe school than under their loving, indulgent and weak mothers.

A railroad brakeman was put on the carpet by a superintendent. He came out from the ordeal and exclaimed: "That is the whitest man who ever lived." "Did he reinstate you?" asked his companions. "Reinstate me! No, he fired me; but he talked to me as if he were my father!"

In practice it is difficult to put up a fair deal unless there are three qualities, and these are rarely found in the same person. The qualities are sympathy, imagination, and above all a sense of justice. Though the combination is rare, the difficulty is not insuperable, for many men competent to be leaders through other qualities possess one or the other of the three essentials; and just as an illustrator, a story teller, and a book maker combine to bring out a great book, or even as two authors will combine like Erckmann-Chatrian, one of whom supplied the Gothic mysticism the other of whom supplied the Gallo-Latin lucidity and proportion for a series of great stories of the border land between Teuton and Gaul, so ought it to be possible to have one man, inspired with sympathy, furnish his altruistic dough; to have another man, inspired by imagination, mould it and bake it into bread; to have a third man, inspired by justice, carve and divide that bread so that each receives his own slice.

At Skagway in 1890-91 were many packers carrying the outfits of the northbound crowd over the White Pass. For ten miles out of Skagway the road was easy, and then for thirty miles over the pass and down the head streams to Lake Bennett it was desperately hard. After securing a contract the common run of packers had just enough imagination to move an outfit the first ten easy miles, there dropping it and returning for another cheap contract. The prices these near-swindlers received were low, since they bid against each other for an easy start, accepting from $0.08 a pound down to $0.04. They had no symapthy with the man whose goods they had dumped before the real work was begun; they had still less sense of fairness, anxious only to take money and not to perform the expected work. A type of a different kind was George Brooks who contracted to deliver outfits at Lake Bennett, 40 miles away, in 48 hours or no pay. George Brooks charged and received $0.20 a pound. He must have been a sympathetic man, for everybody liked him; he had imagination, for he knew that what the most eager men supremely desired was to make prog-

ress; and, charging the highest price he fulfilled his contracts. In spite of $0.20 a pound George Brooks was respected, honored, and even loved. In spite of $0.05 a pound, the cringing horde of near-packers was despised and loathed.

That builder of an imaginary wagon road up the White Pass who induced a Secretary of the Interior under President McKinley to give him a charter to charge toll at the rate of $40 a ton had imagination, but neither sympathy nor sense of fairness; and that Secretary who thus gave to one man for an imaginary wagon road from White Pass up to Summit Lake the right to levy in perpetuity $40 a ton on the prospective 40,000 tons annually going in, had neither imagination, sympathy, nor a sense of fairness. Nobody objects to great reward for great service. It is the insignificant charge for no service that galls. It is great charge for misrepresented service that enrages.

Most good citizens desire to see natural resources conserved, desire to see Alaska well administered, desire to see smuggling stopped; but the great blunders of an ignorant and self-righteous officialdom at Washington and elsewhere which takes tithes of mint, anise and cummin and omits the weightier matters of the law, judgment, mercy and faith—which strains at a gnat and swallows a camel—make many a man regret that the opportunity of 1776 cannot recur. From the government down, through many of the great corporations and labor organizations, there is conspicuous absence of the fair deal.

The successful gambler, the successful prostitute (history rings with the names and fames of both), succeed because they overbalance the hideousness of their callings with their appeals to the imagination, to the sympathies, to the sense of fairness. Let us therefore approach the principle of the fair deal with our imagination, our sympathies, our sense of fairness alert.

The great bulk of the population of the United States, both relatively and numerically, a hundred years hence will be descended from those who are the wage-earners today. What our industrial officers make now of the working army, not Dreadnaughts and fortified canals, will make our future nation. The wage earners are our people and our nation; if not its backbone and skeleton, if not its brain, nevertheless its living flesh and blood. Moreover the burden on them is both exalted and heavy. It is the men closest to their bread and butter who generally have correct instincts as to evils even if they often flounder as to remedies. It is the flesh that quivers with physical pain, not the brain nor the skeleton. It is on these workers that the duty devolves of bringing up respectable families on a small

and precarious income. There is not room for all at the top, even if all were competent to climb, and one of the great problems is to make today bearable without taking away the hope of a better tomorrow.

A boy apprenticed to a trade ought to feel confident that he has not been allowed to enter a race in which even before he started he was hopelessly outclassed; he ought to see before him a reasonable certainty of tenure of position, of definite and increasing wages per hour until he has reached a maximum for his trade and locality; he ought to be assured of decent helpful companions; he ought to be certain that all those things essential to his health and safety which he cannot do himself were being done for him. As to the man, the worker, without whom industry would collapse, all conditions ought to be standardized. Drinking water ought to be germ-free, life-destroying dust should be sucked away, safeguards should surround moving machinery, work illumination should be adequate, not ruinous to eyesight. Working hours should be reasonable and without overtime except in great emergencies, means should be provided for ascertaining directly his needs, his wishes, of listening to his recommendations.

These general welfare considerations have their effect on the contentment of the worker and not one of them is recommended from any patronizing or altruistic motive. A locomotive or other machine is cleaned, housed, kept in repair, given good fuel and good water because its effiiency is thus increased; and in the interests of plant efficiency men should be treated at least as well as we treat machines. It is for mutual, not one-sided, benefit that the workers' counsel is considered.

For many years I was one of the army of workers for a great and progressive western railroad, the "Q" as we fondly called it. I was free to go at any time to the general manager and tell him what I thought of things, of the grade crossing here, of the freight rate that was driving farmers to haul their wheat in wagons instead of shipping it, of the frontier region that needed advances of seed if crops were to be raised the next season. I was one of many paths of communication between this great manager and the people who at once made his road and were dependent upon it. I then came east and lived on the greatest of eastern railroads. I tilted one dark night against the point of one of its crossing barriers. The hurt, severe as it was, enraged me less than the knowledge that I might as well try to change the position of the fixed stars as unofficially to induce a change in a crossing barrier.

Today when at one of the great railroad terminals in New York I walk carrying a heavy grip, 600 measured yards from front of station

to car in which I am to ride; when I have to employ two porters, one a street rover to carry the grip 300 yards to the gate, the other a red-capped part of the organization to carry it the other 300 yards; when I am charged extra on every ticket on account of the privilege of using this palatial terminal—it is not these hardships and grievances that exasperate me, but the knowledge that countless millions of other travelers through all the years to come will have to submit unheeded to the same impositions which spring from lack of imagination, lack of sympathy, lack of sense of justice; and this insignificant matter becomes in the multitude the inspiration for an anti-railroad crusade for which the railroad officials are alone to blame—an anti-railroad crusade as to other matters, which would never have arisen if we could trust instead of fear, a hostility often as unreasoning as the little mistakes and injustices are senseless which stimulated it.

A great railroad superintendent of motive power now at the manufacturing head of one of the largest corporations told me that no unreasonable demand had ever been made on him by a labor organization that he could not trace it back to some act of petty injustice by a foreman of poor judgment.

A French Canadian worker at Montreal in a shop of mammoth proportions, fitted with latest machines, remarked with good natured sarcasm: "It is to be regretted that the distinguished management has not considered it among its obligations to furnish such facilities as would make ordinary decency possible among its employees." Workers do consider and reciprocate as to high or low treatment, but it is not such questions as warm shops, clean towels, filtered water that most deeply and directly concern the man. He is willing to work in dripping and dangerous mines, to work in stifling sweat shops, to take his life in his hands every day provided the wages are tempting. It is about wages, directly or indirectly, that most serious disputes arise. When the French Canadians struck in this Montreal shop, it was not for facilities that would promote decency; it was for more wages, more pay.

It is for this reason that wages loom up as the most important question in industrial life today. The individual is born with the instinct of self-preservation, of race-preservation, of acquisition and hoarding, the latter probably merely a specialized development of the squirrel's nut hoard, the wolf's buried meat. We have interposed the device of wages between basic need and its satisfaction. Wages therefore acquire the importance of both, and wages are also the cushion between anarchy and civilization. Men and women twenty-four hours without food become wild beasts; the human baby becomes fretful

and then an anarchist if there is ten minutes delay, instinctively knowing that nature gave it a mother able instantly to satisfy its craving. We have societies for the suppression of our natural instincts, societies for the prevention of cruelty, for the preservation of birds, for safety appliances, for art collections and for libraries; we have in our legislature, endless debates over insignificant matters; but where is there any rational study of wages, much less any society to enforce fair wages or any legislation in favor of fair wages? Labor unions use the big stick to force wages up, employers make secret combinations to keep wages down, as if a clock, either too fast or too slow, were any good.

Education and form of government are not nearly as important. No other subject is so disturbing, requires so much of the "fair deal." If plans for wage amelioration, successfully tried on a large scale have been at best only experimental, they at least have interest as showing how this delicate subject was approached with the fair deal in mind.

The worker wants as high pay as he can enforce; the employer wants his output to be as cheap as that of his competitors, for if it is not he will be driven out of business. The worker cannot be expected to work for an employer for less pay than is paid under similar conditions for the same class of work by another employer. The wage payer cannot be asked to pay higher wages than the current rate. Because this question is a dangerous explosive, because any stray spark, concussion, or blow may set it off, it should be as far as possible standardized and nine-tenths of the opportunities for clash be eliminated.

As at present paid, wages come neither under status, contract, nor individual effort. Like many other innovations, wages have preserved some of the worst features of all three systems and avoided the best.

The worker is in status when he comes, stays, and goes under the orders of the employer. There is, however, no status when he is laid off without pay or his hours are cut down. He contracts his time for a fixed sum per hour, but he does not, like other contractors, agree to deliver any equivalent in output for the pay received. On day rate and even on piece rate he cannot use individual effort to increase indefinitely his earnings. He is partly a partner since the machines belong to the employer.

Piece rates have offered no solution. They were tried in order to abolish status and substitute contract and individual effort. Status cannot be wholly abolished. A shop is more highly organized than a flock of sparrows or gulls. There must be regular hours, there are so many dependent sequences that individuals must conform to the gen-

eral plan. A piece rate is however an endeavor to establish an output equivalent for money paid.

If a man's wage rate is $0.30 an hour, if it is estimated or guessed that he can do a certain piece of work in an hour, a piece rate of $0.30 is established. He is told to go ahead on the supposition that he will earn more than $0.30 an hour. The employer would be very careful how he attempted to reduce this rate per hour, but if he finds that the worker earns $0.50 an hour he immediately begins to scheme to reduce the piece rate.

When high-speed steel began to come into use, the machine shops at Roanoke of the Norfolk & Western were on piece rates under an agreement. Although the use of high-speed steel on modern wheel lathes has reduced to one hour the time of tire turning which was 18 hours with carbon tools on an old lathe, the machinists refused to permit readjustment of the rates.

It is evident that piece rates installed twenty years ago must be inequitable today.

On the one hand, wages have risen with the increased cost of living. On the other hand, improved facilities have greatly increased the ability to turn out work. Piece rates must necessarily be readjusted and their readjustment is one of the industrial tugs of war.

As to this most delicate of wage questions, peace and harmony have followed the following fair deal provisions.

1.—Decimal wage rates per hour are established.

2.—These decimal wage rates run as local conditions require, from $0.20 an hour down and up in two full cent intervals, therefore $0.16, $0.18, $0.20, $0.22, $0.24, $0.26, etc., perhaps down to $0.06 and up to $0.60 or more.

3.—The wage rate at which a man is engaged or retained is subject to negotiation and agreement between him and the employer.

4.—Men shall not be required to work over ten hours a day without a bonus.

5.—Normal hours shall be nine a day.

6.—A time equivalent shall be determined for every operation.

7.—No worker is under any obligation to attain the time equivalent. His wages do not depend on it, but on the time he is under orders.

8.—Time equivalents are subject to revision either up or down as conditions change, never because of high individual skill.

9.—Revision is made by competent disinterested specialists and both parties know why, when, where, and what revisions are made.

If all these provisions are part of the standard practice of the shop,

if they are accepted when a man contracts his time, serious disagreements can arise only as to (3). It is inevitable that wages will from time to time rise or fall, partly because of varying cost of living, partly because of supply and demand. In certain districts in Alaska, owing to both causes, wages have been as high as one dollar an hour, and when the Klondike gold rush began, nearly all the miners at the great Treadwell Mines near Juneau simply departed. They made no demand for higher wages, realizing that an increase could not be granted, and what they wanted was not an increase of 10 per cent on a $0.30 rate, but a chance to earn $10 to $15 a day.

Standards could, to a large extent, automatically govern promotion from one class to another on account of gain in experience, increased age, or meritorious record. A time ought to come when a wholesale advance or recession in basic rate could be referred to arbitrators or advisory commissions so as to minimize opportunity for disagreement.

The other eight provisions are almost self-evident. Undecimal rates, as 19 4/9 cents an hour, are an abomination and without permanent excuse. At one great establishment where the efficiency of the men in many instances was below 50 per cent, where it averaged no higher than 60 per cent, where an easily to be obtained increase in efficiency of 20 per cent was apparent, the most strenuous and indignant objections were made to standardizing this rate at $0.20. Rates of $13.50 per week divided by 56 hours to find the hourly rate are also an abomination. The greater accuracy of records and the greater accuracy of supervision far more than offsets the slight cost of standardizing upwards irregular rates, even in an old shop.

Since the United States adopted a decimal dollar, I believe in 1804, it does seem ridiculous constantly to revert to quarters and eighths of dollars, or to advance a man a half-cent per hour, or, what is worse, give him an increase of $0.25 a day for a nine-hour day. Calculating machines, wage tables, are only half as large on a $0.02 interval basis as on a $0.01 interval. If a boy is advanced from $0.10 an hour to $0.30 in ten years he can just as well be advanced in two-cent steps as to be advanced in one-cent steps, and the advances can be so timed as not to decrease his aggregate earnings.

It is conceivable that a man working 8 hours can do a full rational day's work. The same work could be done with less wear and tear in 9 hours. Would I prefer to walk 3 miles an hour for 9 hours, or to walk 3.375 miles an hour for 8 hours? I think I might prefer to walk 2.7 miles an hour for 10 hours. A normal work day of 9 hours with temporary variations in gangs between 8 and 10 hours has been found

to work well. If, in balance with the shop, a ten-man gang is working 9 hours a day and one man drops out, until he returns or can be replaced the gang must either work harder, work longer, or disturb the balance of dependent work. Rather than drive harder it is more equitable to pay for the extra normal time required.

Longer hours than 10 are wholly deleterious to both worker and shop. I never knew any advantage to result from promiscuous overtime. It should always be a serious emergency resource, and the bonus should be very high to men and loss of shop efficiency be chargeable to all officials.

The time equivalent for every operation is the key that eliminates misunderstandings. All the great exchange business of the world is today down on a basis of equivalency. A bale of cotton, a bushel of wheat, is standardized at so many pounds and the dollar is standardized at so many grains.

The worker is selling time, just as a coal-mine operator sells coal; but the purchaser is not buying time nor coal; he buys output and heat units. The equivalency between operation and time (not wages) is of transcendent importance, exactly as equivalency between heat unit and fuel is of importance. Happily both can be scientifically and accurately determined, and even if we never realize the equivalent, the starting point for our modern engines and their improvement over their prototypes of fifty years ago is that we know that 776 foot pounds are the equivalent of an increase in temperature of one degree F. of one pound of water.

No maker of an engine is under obligation to realize this equivalent. Neither is any worker under any obligation to attain a time equivalent. His wages do not depend on it. He is paid just the same whether he ever realizes a single equivalent, even though in every case they are equivalents that under standardized conditions and standardized operation are normally attainable. One hundred yards in ten seconds is not a normal equivalent; four miles for a single hour, twenty miles a day for six days each week, are normal equivalents.

Owing to changed conditions, never owing to wages, equivalents to remain fair equivalents must be revised. When a miner of precious ore wishes to sell, when a smelter wishes to buy, neither takes the word of the other. Both employ skilled and certified assayers who assay from the same sample of the ore and determine its value, and if they do not agree other assays are made; on these scientific assays millions of dollars are paid out with never a question or dispute. If accounts between two mercantile firms are muddled, a certified ac-

countant is called in who unravels the truth and on his statement settlements and even court awards are made. Similar revision of equivalents, although no wage rates are involved, should be made by scientific specialists, employing scientific methods, revising solely in the interest of accuracy and truth, never to give either party an unfair advantage. All these provisions have been applied, and applied successfully, on a large scale if not completely all in the same plant. They have worked as intended, they have eliminated wage disputes and wage disagreements, since the inculcated habit of fairness has reacted on the basic wage question and the employer particularly has proved willing without demand to raise the basic rate. The vice-president of a great railroad system of 10,000 miles who has applied many of these provisions to the wage question states as one of his guiding principles that if other roads in his territory increase rates so as to equal his rates, he will at once make a readjustment upward of the basic rates in order to maintain a differential in favor of his employees.

It is unfortunate that the worker concentrates his attention on the rate of wages instead of on what they secure for him. It may be well-nigh impossible to force wages up 20 per cent but it is well known that a French family can live in plenty on what an American family wastes. I know a man, now a millionaire, who at the age of thirty-five was still working for $40 a month as a beef carrier in Chicago. He saved money and bought a farm, sold the farm and went into the milling business. I know another man, now a millionaire, who started as a carpenter, built breweries, saved money until he had a brewery of his own. I know a young man now chief assistant to the executive of a great plant. On a salary of $30 a month he married a thrifty Scotch lassie and the dimes they saved from the start seemed as large as cart wheels.

If the American worker would put efficiency into his family expenditures his income would go 50 per cent further. It is unfortunate that he concentrates his attention on rate of wages instead of on the equivalent he is giving the employer. It is unfortunate that the employer shies at the suggestion of a 10 per cent advance and pays scant if any attention to a 50 per cent inefficiency, two-thirds of which is his own fault. The combination of thrifty worker, high equivalent, fair-minded and progressive employer, wages far above the average, insures lowest costs, just as certainly as piano wire at a high price per pound will make a stronger, longer, bridge than cast iron at one cent a pound.

Like the other efficiency principles the fair deal should be stand-

ardized; it should be moulded by each of the other eleven; it should be under the particular care of a very competent staff official. Provided for in the organization, founded on ideals, on common-sense; developed by competent advisers, simplified by vigorous exclusion of the unfit, the unfair, it should be carried into effect through reliable, immediate and adequate records, through standard practice, definite instructions, through schedules and through all the other efficiency principles.

The fair deal is the last of the five altruistic principles, principles so fundamental that we find them applied by a she-bear to the bringing up of her cubs; principles inculcated by Old and New Testament, inculcated by every great religion.

Benjamin Franklin made a list of thirteen different forms of carelessness into which he knew he would insensibly drift unless he put forth special effort, so each week in each quarter year, he daily observed himself as to one of the thirteen and braced up. Four times a year, for many years, he went through this routine until theory had become habit. The object of collating wise practices of administration under a few simple heads is that each may regularly survey his own task from the point of view of each one of the principles, and thus not only prevent the backsliding that ultimately results in disaster, but make forward progress so that he who started as a disciple soon becomes a master to whom we turn for competent counsel.

The next five principles, (therefore not including the last two, standardized operation and efficiency reward,) are not practiced by the she-bear, are very inadequately inculcated by the great religious teachers.

They are as modern as the gas engine, the dynamo, the steam turbine; they are almost as modern as the flying machine; they are evolved to cover modern complex conditions. The sequence in which they will be discussed is not essential. Records will be first considered, but records can be neither reliable, immediate, nor adequate until nearly everything else has been standardized. The subject of records will therefore, of necessity, be treated theoretically, showing at least the backbone of essential records from which less essential records spring like ribs. There are records of standard condition, of standard operation, records of discipline and records of the fair deal; but the essential records of cost and efficiency will be developed from an underlying, universal and exceedingly simple formula, which covers operating efficiencies and stardard operating costs of materials, of men, and of installation.

EDITORIAL COMMENT

The Latest Transatlantic Steamship.

WITH the launch of the Olympic the White Star again took the lead among the mercantile fleet owners of the world as possessing the largest ocean carrier. The Ismay traditions have been fully maintained in this splendid accession to its transatlantic liners. But present-day ambitions of ship-builders do not rest content with the achievement of a single vessel. The construction of duplicates or alternatives is seen to be real economy by lessening the risks and losses of break-downs and delays. In the case of the Cunard sister ships, the Mauretania and Lusitania, the interchangeability of parts in the machinery has been found to save time in repairs and to afford other advantages and safeguards. The Olympic is even more fortunate in that her twin, the Titanic, has been built by her side on the Belfast stocks and it has therefore been a comparatively easy matter to work out the designs of both ships together. What better example could be given of prevision and engineering organization as applied to the shipwright's art and practice than in the Harland and Wolff yards for this gigantic undertaking!

That at the critical moment the mass of 27,000 tons glided into the water in sixty-two seconds without the slightest hitch was a compliment to the perfection of the arrangements by which ships approaching a thousand feet in length are nowadays set afloat. Since the foundation of the White Star line forty-one years ago Harland and Wolff's have been responsible for the construction of the Ismay ships, the Cedric being an exception. The pioneer vessel of the fleet was the first Oceanic, which made her first voyage to New York in March, 1871. She was 430 feet long and of 3,807 tons. It is interesting to note that the launching apparatus employed for the Olympic 882½ feet long and 92½ feet broad was much the same as that employed for the launch of the Oceanic in 1899. That ship of 17,274 tons and 705½ feet long eleven years ago considerably exceeded any vessel then built or building. It does not seem that the trigger arrangement for releasing the ship cradle has been improved upon in the time which has seen the development in size of vessels measured by the Olympic and Oceanic relatively. An idea of the enormous weight involved is realized perhaps more fully by the fact that the rivets in the completed ship number about three millions weighing 1,200 tons. The Olympic rudder itself has a weight of 100 tons and the engine crank shafts are 118 tons each. Such good performances had been given by the Laurentic that the owners and engineers had little hesitation in adopting for the Olympic the combination system of propulsion by high-pressure reciprocating engines and low-pressure turbines.

In the keen rivalry that exists between the British and German lines for the supremacy of the Atlantic it would be futile to suppose that the development of engines is nearing the general acceptance of any standard type. The Olympic will enter into the race next year, with the prospect of even larger and more powerfully engined vessels soon to be pressing on her heels. But her record size for the time being will force to an immediate issue considerations of docking facilities both in the channel and at New York.

Built primarily for comfortable passenger service it would be a drawback to the special accommodation given in such ships as the Olympic for these big vessels to be debarred from landing trav-

elers in the heart of New York city by want of adequate piers though the waterways are entirely suitable. Southampton has set its dock engineers to work to provide safe berths for these giants of the ocean. It will be strange if New York does not similarly adapt its naturally advantageous water front to present and future needs without necessitating the inconveniences that would be inseparable from disembarking at such a distance from the city as Montauk Point.

The Commercial Motor-Vehicle.

AMONG the engineering societies which began their winter's sessions with inaugural addresses the Institution of Automobile Engineers was distinguished by the valuable review of motor-car development made by its president, **Mr. F. W. Lanchester.** The pleasure or passenger motor-car's status is well assured and the fifteen years of development in the modern period have resulted in standardization according to one general plan of construction. Manufacturers are now concentrating their attention upon the motor car intended for commercial and business purposes. Mr. Lanchester confessed that some years ago, after investigating the difficulties that beset the substitution of motor vehicles for horse traction, he was reluctantly obliged to give the advice to continue with horses as no saving was then to be expected from the change. Apparently he is not much more hopeful now, and certainly does not have the optimism of Mr. Edison, who would be content with little less than the complete banishment of the horse from the streets. When even the brewer's stable, however, is not being kept up but the best dray-horses are being replaced by the motor in wagon, truck, and light van the change is taking place more swiftly and steadily than is apt to be noticed.

On all hands it is anticipated that the next big expansion of the automobile industry will be in the direction of the heavy commercial vehicle. Mr. Lanchester, concurring in that view, lays stress upon the two main factors that check a rapid transition to the general run of the commercial motor car. The cost of materials, especially fuel, is a serious obstacle particularly owing to the market fluctuations. The motor car is the result of the combination of a number of modern inventions, recently utilized, or natural products like aluminium, caoutchouc rubber, and mineral oil used both as fuel and lubricant. The range of prices of these factors has a much more important bearing on the successful manufacture of the commercial motor-vehicle than of the pleasure motor-car which is primarily a luxury, and uncertainties as to the price of these materials have caused many miscalculations and disappointments for the manufacturer. It looks, however, as if the three articles mentioned may all be cheaper in the future. Aluminium since 1900 especially has declined in price by more than half. Rubber has, according to the best judgment, reached its zenith in price and in two or three years there need be no fear of short supplies. The opening of new oil-fields also promises benefit from fresh competition.

In the probable mechanical improvements Mr. Lanchester looks for further reduction of vibration and for better self-starting apparatus, but for no revolutionary change from the present accepted type. After all is said and done, however, the second main factor in bringing the commercial motor-vehicle into universal use is good roads. Here the road engineer controls the situation.

A YEAR'S PROGRESS AT PANAMA.

A REVIEW OF PROGRESS IN EXCAVATION AND CONSTRUCTION DURING THE YEAR ENDED JUNE 30, 1910.

Annual Report of the Isthmian Canal Commission.

THE impression of effective activity and rapid progress left by the perusal of Mr. Fullerton L. Waldo's record of personal observation of the work on the Isthmus, published in THE ENGINEERING MAGAZINE for October, is substantiated by the annual report of the Isthmian Canal Commission for the fiscal year ended June 30, 1910, which has just been released for publication. We give below a brief abstract of those parts of the report which deal with the progress made in excavation and construction, and we would refer our readers, for a *resumé* of the state of the work at the end of the preceding fiscal year, to a similar abstract published in these columns in our issue for December, 1909. On page 388 *et seq.* of this issue will be found a number of interesting photographs illustrative of certain features of the work.

The general designs of the upper locks at Gatun and of the locks at Pedro Miguel were described in the annual report for 1909. During the year covered by the last report, the engineering force has been engaged in the preparation of detailed drawings for the construction of these works, and in the development of the general plans for the intermediate and lower locks at Gatun and for the flight at Miraflores. In the lock designs has been included an approach wall in prolongation of the wall separating the twin locks, against which vessels are to moor, the wing walls being judged unsuitable for this purpose. Contracts have been let for all the frames for the gate valves required to control the main culverts for the upper Gatun and Pedro Miguel locks, for the frames and moving parts of two sets of Stoney valves, and for the forty cylindrical valves required for the two locks under construction. The contract has been let also for all the gates required to equip all the locks when completed, at a price of 3.785 cents per pound for structural steel erected, 2.62 cents per pound for steel not erected, and $5,374,474.82 for the entire work; the erection of the 46 gates, or 92 leaves, is to be completed by June 1, 1913. The electrical machinery for the operation of the Stoney gate valves and the cylindrical valves has been completed, and careful study has been given to the design of the machinery for operating the gate leaves. For the spillway dam at Gatun a general design has been adopted, which calls for a dam semicircular in trace, and in cross section an ogee, made up of an arc of a parabola, a tangent, and an arc of a circle. The crest of the dam is divided into 14 bays, 45 feet wide, closed by means of Stoney gates. When the lake is at plus 87, one bay with the gates fully opened will discharge 11,000 cubic feet per second.

At the site of the Gatun locks, the excavation for the upper locks, and for the intermediate locks with the exception of the trenching required for the lateral culverts, has been completed. On June

30 last, 375,000 cubic yards remained to be excavated for the lower locks. In the lock chambers the excavation during the year has amounted to 3,965,699 cubic yards in the dry, and 435,178 cubic yards in the wet, and in the auxiliary work to 646,520 cubic yards. The average cost of excavation, during the six months ended June 30, was, including all charges, $0.6751 per cubic yard. The concrete mixing and handling plant described in the annual report for 1909 gave considerable trouble when first installed, but since April has operated without difficulty. The total amount of concrete laid during the year was 513,803 cubic yards, at an average cost per yard in place, including all charges, of $7.355. To complete the Gatun locks, including the approach and wing walls, 1,532,297 cubic yards of concrete remained to be placed on June 30.

At the site of the Gatun dam, at the close of the fiscal year, the north and south toes of the portion of the dam east of Spillway Hill had reached an elevation of 65 feet above mean tide, and the hydraulic fill between the toes, an average elevation of 51 feet. West of Spillway Hill the north toe has been carried to an elevation of plus 30, and the south toe to an elevation of plus 35. The total amount of material placed in the dam during the year was 2,577,234 cubic yards of dry fill, estimated on car, and 2,933,175 cubic yards of hydraulic fill. The average costs for the last six months of the year were 28.19 cents per yard for dry fill and 32.54 cents per yard for wet fill. Excavation for the spillway resulted in the removal of 127,210 cubic yards, which completed the excavation for the floor, for the curtain and side walls, and for nearly the whole of the foundation of the spillway dam. In the floor and side walls 53,632 cubic yards of concrete was placed, at an average cost for the last six months of the year of $8.602 per yard.

Work was begun last March on a levee 1½ miles long, connecting Spillway Hill with Mindi Hills, which is to close the French canal to access of the waters of the Chagres River passing through the west diversion. This levee will prevent the recurrence of floods such as caused the suspension of excavation in the Mindi section on November 20, 1909. The excavation in this section during the year amounted to only 91,572 cubic yards of earth and 233,144 cubic yards of rock. The average cost was 62.18 cents per yard. At the time work was suspended the deepest part of the cut had reached a depth of 42 feet below sea level.

The dredges in operation between the Mindi Hills and the Caribbean during the year removed a total of 4,556,375 cubic yards of earth and 399,285 cubic yards of rock from the canal prism, at an average cost of 23.60 cents per cubic yard. The dredges handled also 3,206 cubic yards of earth from approaches to the Gatun docks, 69,844 cubic yards of earth and 55,036 cubic yards of rock from the French canal, 247,537 cubic yards of earth and rock from the Cristobal terminals, and 501,928 cubic yards of earth and rock from the approach channel leading from the canal to Cristobal Harbor. The silting between miles 1 and 3 amounted during the year to 955,287 cubic yards; the total fill is estimated at 3,500,000 cubic yards. The breakwater running out to 44-foot depth in Limon Bay was definitely located in March last, as was also the canal channel through these waters.

In the Chagres district the work of cutting through the 23 peninsulas formed by the tortuous course of the Chagres River, designated, from Gamboa, Points 1, 2, 3, etc., has been continued. The completion of the cut through Point 2 was reported in the annual report for 1909. Work on Point 1 was completed May 28, 1910, with the excavation of 1,246,761 cubic yards (286,560 yards during the last year). At Point 3, 832,646 cubic yards were removed; at Point 4, 10,646 yards; at Point 5, 23,824 yards; at Point 6, 46,741 yards; at Mamei, 372,671 yards; at Caimito, 338,675 yards; at the Cano River cut, 707,031 yards; at Tabernilla, 393,490 yards; at Buena Vista, 153,026 yards; and smaller quantities at other places. The total amount removed from the Chagres section from the beginning of operations to the close of the last fiscal year was 9,497,673 cubic yards, leaving still to be excavated 3,415,944 cubic yards.

During the fiscal year 14,921,750 cubic yards were excavated from the Culebra cut, leaving 34,893,531 cubic yards to be removed before this section is completed. This amount includes an increase of 6,408,560 yards over the estimate made in September, 1908, a part of which is to provide for the widening of the canal north of Pedro Miguel lock, but the greater portion to allow for slides and breaks. In addition to the slides, which have always been troublesome, a number of breaks have occurred in the banks of the canal. The largest break, on the west bank of the canal at the town of Culebra, covers an area of 10½ acres; from this break 1,500,388 yards were removed. From another break directly across the canal 314,184 yards were removed, and still another break has occurred at La Pita Point. Cucaracha is still the most important of the slides; 639,239 yards were removed from it during the year. The slides at New Culebra, Whitehouse, and other points were active also. The total amount of material removed from all slides and breaks in the central division during the fiscal year was 2,649,563 cubic yards, or about 15 per cent. of the amount removed from the Culebra cut. The average cost of excavation for the year was 66.99 cents per yard.

At Pedro Miguel, work was continued in excavating the lock site and the approaches from the south. Two slides increased the amount to be removed by 75,299 cubic yards of earth and rock. The total excavation was 343,448 yards, at an average cost of $1.188 per yard for the 279,364 yards of excavation proper. In preparation for the foundations 64,084 yards were removed by hand at a cost of $2.8193 per yard. The plant for the construction of the locks was installed and a total of 166,869 cubic yards of concrete was laid at an average cost of $6.089 per yard. The total amount of concrete required is 858,600 cubic yards. Filling back of the west wall was begun about June 1, and by the end of the month 9,616 cubic yards had been placed. Within the year, 51,827 cubic yards of material has been added to the impervious portion of the west spoil dam, and 41,964 cubic yards to the toes, at a cost of 38.6 cents per yard. The material was largely derived from the excavation of the canal prism below the Pedro Miguel lock site, where 99,703 yards were removed at a cost of $0.6345 per yard.

The excavation for the upper locks of the flight at Miraflores was practically completed during the year, and the work of preparing the foundations, erecting concrete plant, and placing concrete began. The total amount excavated was 293,829 cubic yards, at a cost—for the last six months—of $1.369 per yard. Of this amount 157,483 yards was placed in the toes of the Miraflores west dam, and 121,080 yards was used as back fill. A 20-inch suction dredge worked in the lower lock site until late in December, 1909, when it was removed on account of the unsatisfactory conditions. Its total output was 141,759 cubic yards at an average cost of 50.63 cents per yard. The remainder of the material will be excavated by hydraulic means.

The work of preparing for foundations in the upper locks was done by steam shovel and by hand, the 24,655 yards of steam-shovel excavation costing $1.947 per yard. The total amount of concrete laid during the year was 1,630 cubic yards, at an average cost of $7.393 per yard. The estimated amount of concrete required for the locks, including approaches and wing walls is 1,327,300 cubic yards. Power for the operation of the construction plant at Miraflores, for the crusher plant at Ancon, and for the sand unloading cranes at Balboa is furnished by a power station which was finished during the year at a total cost of $486,096.82.

The west dam, extending from the head of the locks to Cocoli Hill, consisting of two mounds or toes made up of waste material obtained from lock excavation, mostly rock, and of hydraulic fill between them, received during the year 157,483 cubic yards of material in the toes, at an average cost of $0.6774 per yard, and 120,910 cubic yards of impervious material.

The material to be removed in the two-mile stretch of channel below Miraflores locks amounts to about 9,650,000 cubic yards, of which over 1,500,000 is rock,

Lack of a sufficient number of dredges has led to the adoption of hydraulic methods for the removal of the earth. South of the area to be excavated by hydraulic means, the necessary depth and width of channel will be secured by ordinary dredging operations. The total output of the dredges which worked during the last fiscal year was 6,914,384 cubic yards, at an average cost of 24.08 cents per yard. The rock is prepared for handling by the dredges by drilling and mining, subaqueous blasting, and rock breaking.

The appropriations made by Congress for the Isthmian Canal and available to the close of the fiscal year 1909 amounted to $210,146,468.58, or 56 per cent. of the total estimated cost of the canal, which is fixed at $375,201,000. On June 25, 1910, $37,855,000 were appropriated for the fiscal year 1910-11, leaving $127,199,531.42 of the estimated total cost of the canal to be appropriated. The total classified expenditures for canal work to June 30, 1910, amounted to $191,258,113.93, of which $31,188,426.37 was the net expenditure during the fiscal year covered by this report. Of the total classified expenditures to June 30, 1910, $25,699,450.81 were for plant and equipment for construction work, of which $4,388,511.55 were expended during the fiscal year.

THE FRENCH RAILWAY STRIKE.

A REVIEW OF RAILWAY CONDITIONS IN FRANCE, THE CAUSES OF THE STRIKE, AND THE SIGNIFICANCE OF THE RESULT.

The Engineer.

THE significance of the recent strike of the railway employees in France lies in the fact that to the strike promoters the improvement of the condition of railway labor was a secondary consideration. Fundamentally the contest was not one between labor and capital, but between militant socialism and the authority of Government. The strikers were completely under the control of the Confédération Générale du Travail, and were used merely as a tool to further the revolutionary schemes of that organization. Although the failure of the socialist agitators to attain their ends was complete, disastrous consequences to the State were very narrowly averted, and the whole history of the strike offers the clearest possible exposition of the perils besetting a Government which accepts, to the extent to which it is accepted in France, the principle of Government ownership or control of public utilities.

"The strike of the railway men in France," says an editorial in *The Engineer* for October 21, "offers the strongest condemnation of the system of State control of railways. To understand the cause of the strike it may be necessary to explain the conditions under which railway enterprises are carried on in France. Being an essentially military country it is desirable that the Government should exercise a certain control over the railway companies to ensure that they are always capable of transporting the maximum number of troops at almost a moment's notice. If the control were limited to this supervision there would be no reason for complaint, but the French Government carries its interference much further. It should not be overlooked that the companies exist on sufferance—that is to say, their concessions are held for a certain period, after which the lines, with their equipment, descend to the State. In the meantime the railway debentures are guaranteed by the Government, which has for many years been paying interest on such stock of certain companies. There is consequently a very close association between the companies and the State, to the extent even that the companies can do nothing without the sanction of the Minister of Public Works. No permanent construction can be made, and no improvements carried out, before the plans and the expenditure have been approved by this department. Railway fares and traffic charges have to be submitted in the same way. It may, indeed, be said that the companies are

merely running the lines in trust for the State.

"To imagine the situation created by thus subordinating the railway companies to the will of Parliament is easy. In a country so strongly dominated by the Socialist element the Government is continually exhorted to adopt 'democratic measures,' which, in the case of the railway companies, means the fixing of low third-class fares, and the compulsory running of unprofitable services to satisfy the demands of deputies from districts where the traffic has not justified the companies in putting on more trains. Then there is the abuse of free passes, which have to be accorded to all the deputies, senators, and civil servants, as well as to all sorts of people who have sufficient political influence to enable them to travel free. These are only a few of the burdens under which the companies labour, but they are sufficient to show that the companies do not possess that freedom of action which is necessary to the satisfactory management of a commercial or industrial enterprise. Finding their receipts seriously curtailed by these political exigencies, the companies have been obliged to effect economies wherever possible, and there has consequently been some delay in giving satisfaction to the railway men over the question of wages. Nevertheless, it cannot be said that the situation of the men is so unsatisfactory as is represented in the manifesto which was prepared by the strike committee for the public edification. The men are claiming a minimum wage of 5 francs a day, and it is asserted that on some lines the minimum wage is only 3.50 francs a day, which, naturally, would be wholly insufficient in view of the higher cost of living for the men in and around Paris. To this sum, however, which is represented as the minimum wage, must be added various other pecuniary advantages which finally bring the total amount paid to the men to a much higher figure. The minimum wage, being based upon the cost of living in country districts, is increased by an indemnity to men who live in and around Paris, and in addition to this, a certain amount is allowed for families, which, on the State railways, bring the minimum amount paid annually to each man to 1,619 francs. Apart from this, each man has a certain number of free passes for himself and his family over the entire railway system, he is accorded free medical treatment, he is paid during illness, and he is allowed fifty-two days' holiday during the year. Consequently, with a maximum of 314 days a year, he receives a minimum of 5.16 francs, which is about 4s. 1d. per working day. Promotion naturally awaits every man who displays ordinary zeal in the exercise of his duties. On the other lines the situation of the men is scarcely less satisfactory. The companies have for two years past been devoting an increasing sum of money to the welfare of the men, amounting in one case to 4,000,000 francs; but the minimum wage, which was the chief point of conflict, remains in abeyance. As the result of the agitation of the National Railwaymen's Union, the Prime Minister obtained from the companies a promise to consider favourably the men's claims, but before this could be done the long-threatened strike was declared.

"There are probably few classes of workers possessed of less revolutionary tendencies than the French railwaymen, and yet the strike is regarded by the Government as of a distinctly revolutionary character. Here, again, we see the serious inconvenience arising out of the State control of a commercial enterprise of national importance. The strike has been seized upon as a means of destroying the Government and existing social institutions, not by the railwaymen themselves, but by those behind them. . . . . It may be affirmed that the great majority of railwaymen honestly believed that the strike would be ended in forty-eight hours. The men could not imagine that Paris would stand the ordeal of complete isolation for a longer period. Had the calculations of the strike promoters not miscarried the consequences would have been disastrous. For a time a general strike seemed quite within the range of probabilities. . . . . Undoubtedly a great factor in preventing the extension of the strike was the calling up of the mili-

tary reserves forming the Railway Corps. This was a bold step, because, had the men refused to obey, the condition of things would have been little short of anarchy, and this contingency was deemed quite possible in view of the way in which the Union was dominated by the revolutionary element of the Confédération Générale du Travail. Fortunately, the men responded on all the lines except the Nord and the Ouest-Etat, where a large number refused to serve, although the fear of the consequences, together with the conviction that the strike was turning against them, caused an increasingly large number to put in an appearance, until on the Nord and Ouest-Etat the engine-drivers and other servants were in sufficient force to allow of the service being partially resumed. This was the beginning of the end, and every day saw large additions to the ranks of workers, until the Railwaymen's Union was obliged to give in. The whole of the railway system in France is under military mobilisation, exactly as it would be under actual war conditions. Disobedience may be dealt with by court martial, and this, as well as the fear that those who delay their return to work may be discharged, has had the effect of completely breaking down the resistance of the men.

"The significance of this strike lies in the fact that it represents one of the greatest struggles that have yet taken place between militant socialists and the authority of Government. The postmen's strike last year failed mainly because there was a want of sympathy between the men and the revolutionary agitators, and these latter thought they had greater hope with the railway workers, among whom there was undoubtedly a strong socialist element. It is difficult to imagine how the ends of the strike promoters could have been better served than by a complete suspension of the entire railway service. They have fortunately once more failed to attain these ends, and having 'shot their bolt' for the time being, there is every probability of these fomenters of disturbance being reduced to a state of inaction. The Government also has seen the danger of allowing the railwaymen too much liberty in the way of breaking contracts with the companies. Whether the men employed upon a great national enterprise like the railways have the right to strike has long been discussed, and was admitted by the Government, but it is understood that the Government intends to introduce a bill whereby this right will be restricted, especially in the way of intimidating workers who do not belong to the union, or of interfering with those who refuse to strike. The events of the past week have emphasised very strongly the vital part played by the railways in the life of the country. So much has been said about the possibilities of mechanical road locomotion that it was supposed by a large section of the public that railways were becoming less of a necessity than formerly, but the temporary isolation of Paris from North-West France has brought home to the public the supreme necessity of an adequate railway service, and it may be taken for granted that precautions will be adopted in future to prevent a recurrence of such a disastrous strike."

THE GROWTH OF STEAMSHIPS.

A DISCUSSION OF THE INCREASE IN THE SIZE AND SPEED OF STEAMSHIPS SINCE THE *GREAT EASTERN*, AND OF THE CONSIDERATIONS AFFECTING FURTHER INCREASE.

Sir William H. White—Times Engineering Supplement.

LITTLE more than three years has elapsed since the launching of the *Lusitania* and *Mauretania* gave to the world, to quote Harrington Emerson, its seventh modern wonder. The speed of these monster vessels was so great as apparently to discourage all competition, and they remain the undisputed speed champions in the Atlantic, the scene of intense rivalry among shipping lines since the earliest days of steam navigation. In place of the competition for the Transatlantic speed record, however, there has arisen a compe-

tition in size of vessels, in which the giant Cunarders are already outclassed. The *Olympic* of the White Star Line, which was launched at Belfast on October 20, and her sister ship the *Titanic,* which is far advanced in construction, exceed the *Lusitania* and *Mauretania* in length by 92 feet, and in gross tonnage by over 11,000 tons. Larger still is the vessel recently ordered by the Hamburg-American Company, and the Cunard Company is reported to be considering the construction of a ship superior in size to any of these, designed to restore to the Cunard Line its lost pre-eminence.

It may well be asked where this competition is to end. Sir William H. White, who discusses the growth of steamships in the *Times Engineering Supplement* for August 31, believes it is impossible to predict what will happen in the future, except that the determination of the limit of size of steamships will be based upon commercial considerations.

"The new vessels of the White Star and Hamburg-American Lines represent a great step in advance of the largest Transatlantic steamers of the 'intermediate' type previously built. The *Adriatic* for example, which was launched about the same time as the *Mauretania,* is nearly 726 feet in length (over all), 75½ feet broad, 58 feet deep, 24,500 tons (gross), and is propelled by twin-screw reciprocating engines of about 15,000 horse power at an average speed of 16 to 17 knots. The North German Lloyd's steamship *George Washington,* which made her maiden voyage last year, is about equal in length to the *Adriatic,* is 78 feet broad, 54 feet deep, of 25,500 tons (gross), has engines of 20,000 horse power, and has made passages at an average speed of 19 knots. At a load draft of 33 feet her displacement is said to be about 37,000 tons, and her cargo capacity 13,000 tons. The largest ship of the Hamburg-American Line now on service, the *Kaiserin Augusta Victoria,* was built in 1905. She is nearly equal to the *Adriatic* in tonnage, about 2 feet broader, and 30 feet shorter. The vessel just ordered will be 30 per cent longer than the *Kaiserin* and 80 per cent greater in tonnage.

	Great Eastern.	*Lusitania* and *Mauretania.*	*Olympic* and *Titanic.*	Hamburg-American Steamship.
Length over all, feet	693	790	882	910
Length between perpendiculars, feet	680	760	850	879
Breadth, extreme, feet	83	88	92½	95
Molded depth, feet	58	60½	64½	64
Draft of water (laden), feet	34	34	34	34
Displacement at load draft, tons	32,000	39,000	50,000	52,000
Gross tonnage, tons	18,915	32,000	43,300	45,000
Horse-power	8,000	75,000 (shaft.)	40,000 to 45,000	60,000
Sea-speed, knots per hour	14	25½	21	22
Type of engine	Combination of paddle-wheels and single screw.	Parsons turbines, 4 shafts.	Combination of twin reciprocating engine and low-pressure turbine, 3 propellers.	Turbines, 4 shafts.

The accompanying table gives the principal data of the vessels mentioned above, and also of the *Great Eastern.* A uniform draught of 34 feet—the deep-load draught of the *Lusitania* and *Mauretania*—has been assumed for all the ships. All the vessels, of course, could be safely loaded to deeper draughts if port facilities were available at all times. This draught, however, is the maximum which can be contemplated for the ports of Liverpool and Southampton, and very close to the maximum for New York, even when the Ambrose Channel is completed. The displacements given in the table are approximately correct for this assumed draught. The figures for horse power are necessarily only estimates, but are very close to the powers necessary for the contemplated speeds.

"From the foregoing figures it will be seen that the last five years have been marked by rapid and enormous increase in the dimensions of steamships, the 'biggest ship' laid down having been speedily deprived of that distinction. The contrast between existing conditions and those which formerly prevailed is remarkable. More than 40 years after the *Great Eastern* began her Transatlantic service (June 17, 1860), she remained unsurpassed in size, although the chief features of her design had been deter-

mined by Brunel in 1852-3. Commercially that ship was a failure; from the scientific and technical sides she will always remain a marvel of professional skill and courage in facing new conditions and going far beyond precedent. Until the *Cedric* of the White Star Line was built (1903) the *Great Eastern* was not surpassed. Brunel worked under great disadvantages as compared with his successors of to-day in regard to materials of construction; yet by skilful structural design and close attention to details he produced a vessel in which the weight of hull in proportion to dimensions, displacement, and carrying power compared favorably with the corresponding proportions in the largest steel-built vessels of the present day.

"The last half-century has witnessed great improvements in the materials and methods of shipbuilding and in marine engineering; there is consequently no reason for supposing that further increase cannot be made in the dimensions and speeds of ships if commercial considerations should make that course desirable, and if the necessary financial provision were made for the construction of larger ships and for suitable dock accommodation at terminal ports. Shipowners and dock proprietors, not naval architects and marine engineers, will have to decide where and when increase of size and speed shall stop.

"It has been explained above that the latest additions to the dimensions of ships have been made in vessels of the 'intermediate' type, for which the speeds contemplated are considerably below the speed of the great Cunarders, and are moderate in relation to the dimensions of the ships. The engine-powers and coal consumptions are, of course, much reduced in consequence of the lower speeds accepted, and the vessels will possess much larger cargo capacities than the *Lusitania* and *Maurctania*. Opinions may differ in regard to the probability of this great cargo capacity being fully utilized for most of the voyages made each year, and it is understood that existing ships of the intermediate type rarely find cargoes, even when coming eastwards, which bring them down to their deep-load lines.

"Further increase in the size of steamships would undoubtedly be accompanied by economy in the cost of over-sea transport of cargoes. Brunel understood and clearly stated this law nearly 60 years ago, and it is of universal application when ships are under way at sea. On the other hand, if increase in size and cargo capacity should be associated with longer periods in port, made necessary by the collection, shipment, and discharge of larger cargoes, or if, as a rule, full cargoes could not be secured for these very large ships, the consequent diminution of earning power, together with the increased first cost of the ships, the larger allowances for depreciation and interest on capital, and the lessened proportionate service at sea might outweigh any economies in cost of transport obtained by increased dimensions. In this way it is possible that a limit may be put to increase in size. Moreover, the great expenditure involved in the provision of suitable accommodation for very large ships in docks and harbors is already felt by the proprietors and authorities. Large expenditure has been faced at London, Liverpool, Southampton, New York, and other ports in deepening and widening channels, constructing floating and dry docks, and providing generally for ships of the largest size; but it is possible that on this side also commercial considerations may prevail, and the rapid progress in dimensions of the last few years be checked simply because it is found that, on the whole, it does not pay.

"Increase in dimensions of ships is, as a rule, accompanied by greater steadiness, better behavior, and more uniform maintenance of speed in stormy weather. Speaking broadly, it may be asserted that a point has already been reached where the dimensions of ships in proportion to the lengths and heights of the largest waves are such as to secure the power of maintaining practically uniform performance, and of securing steadiness and good behavior in all weathers and conditions of the sea. Consequently, from the point of view of behavior and the maintenance of uniform speed, no further considerable increase in size in Transatlantic steamships seems to be necessary.

"No doubt it is possible to provide more varied, extensive, and luxurious accommodation in larger ships, and some slight improvement in average behavior may accompany increase in dimensions. Many passengers even now prefer to cross in slower but very comfortable intermediate steamships of large size and moderate engine power; their preference is likely to continue and may ensure satisfactory employment for the larger vessels now building or for still larger vessels. On the other hand, high speed and quick passages will always be sought for by many, if not most, persons to whom time is important. With turbine propulsion it is possible to prevent any sensible vibration and to avoid discomforts such as are inevitably experienced in swift steamers driven by reciprocating engines. Every one who has taken passage in the *Lusitania* or *Mauretania* since their screw propellers have been changed will confirm this statement, and there can be no question as to the possibility of securing equally satisfactory conditions with even still faster and larger vessels.

"In view of what has happened in the past, it is not possible to predict what will happen in future, but it seems certain that commercial considerations will predominate."

WATER VELOCITY IN SURFACE CONDENSERS.

A STUDY OF THE RELATION OF THE VELOCITY OF THE CIRCULATING WATER TO CONDENSER-PLANT ECONOMY.

R. M. Neilson—The Engineer.

IT is well known that the velocity with which the circulating water passes through the tubes of a surface condenser has a decided influence on the economy of the installation. High velocity is conducive to a high rate of condensation and permits the employment of a comparatively small area of cooling surface; but, on the other hand, high velocity involves a large expenditure of power for pumping and necessitates the employment of a powerful pump and driving motor. Above a certain velocity the beneficial effect of increased rate of condensation is relatively small, while the pump power rises at an ever increasing rate. Below a certain velocity the reduction of pump power is negligible, while the decrease in the rate of condensation is very marked. There is, therefore, for every case, a certain velocity which will give most the economical results.

The limits within which this best velocity lies and the method by which it may be ascertained for any case are discussed by R. M. Neilson in *The Engineer* for September 9. In Mr. Neilson's opinion, the velocity should not be finally decided upon until the internal diameter of the condenser tubes and the quantity of water to be passed through the tubes per minutes have been determined. Previous articles in *The Engineer* have discussed the problems of tube diameter and quantity of water; to a review of the latter we devoted considerable space in our September issue. We now give in abstract Mr. Neilson's examination of the problem of velocity, with reproductions of a number of the more important of his illustrative diagrams.

Let t_1 and t_0 be, respectively, the inlet and outlet temperatures of the circulating water in degrees F.; t_v, the temperature of saturated steam corresponding to the vacuum; δ, the difference between t_v and t_0; K, the amount of steam, in pounds, which can be condensed per square foot of cooling surface per hour per degree F. difference in temperature between steam and water; p, the absolute pressure in the condenser in pounds per square inch; Q, the weight of water circulating per hour in pounds; H, the head required to drive the water through the condenser in feet; and v, the velocity of the water in feet per second.

It is known that the condensation rate is influenced by the velocity of the circulating water to a great extent at certain velocities and to a less extent at higher velocities, but the precise nature of the relation between K and v cannot be said to be settled. There is reason, however, to believe that K is influenced

by variation of v in a manner which can be expressed by the equation

$$K = \frac{C_1}{C_2 + \frac{C_3}{C_4 + v}}$$

where C_1, C_2, C_3 and C_4 depend on the vacuum within the condenser, the amount of air, the cleanness and diameter of the condenser tubes, and the general design of the condenser. There can thus be an infinite number of curves connecting K with v. Three curves shown by Mr. Neilson illustrate the fact that as v increases, dK/dv is a diminishing quantity; or in other words, the rate of increase of K with increase of v diminishes as v rises in value.

The frictional head which has to be overcome in pumping the circulating water through a condenser varies—approximately at least—as the square of the water velocity. It is further affected by the velocity in an indirect manner. For a constant hourly flow of circulating water and a constant internal tube diameter, the number of tube elements must vary inversely as the velocity. As the tube elements are reduced in number—to suit increased water velocity—they must be increased in length to give the requisite cooling surface. This increase in length may necessitate an increase in the number of water passes to avoid an excessive tube length, and both these increases augment the frictional head in a manner indirectly dependent on the velocity.

Mr. Neilson demonstrates mathematically that H varies as a power of v, whose index is variable but always greater than two. An inspection of curves connecting H and v and K and v shows that at high velocities the head increases at a very rapid rate, while K increases but slowly. At low velocities, on the other hand, change of velocity produces but little effect on the head, while it has a very material effect on K. These curves alone are sufficient to prove that extremes of velocity are undesirable. The determination of the best velocity requires a consideration of the cost of the condenser cooling surface, the effect of variation in the frictional head on the cost of the pump and driving motor, and the cost of energy to drive the pump. If the plant is to be employed nearly continuously, the cost of energy is obviously of more importance relatively to the initial cost of the plant than if the plant is run only a small fraction of the total number of hours in the year. The whole problem is of somewhat the same nature as that dealt with in Mr. Neilson's previous article on the determination of the best value for δ, which was reviewed in our September issue.

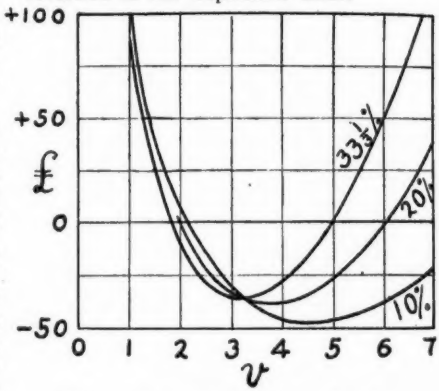


FIG. I. NO EXTERNAL HEAD. $\delta = 20$.

Figures 1, 2 and 3 show the best velocity to employ when the head to be overcome is only the frictional head within the condenser; a total absence of external head is assumed. In each case the plant is assumed to have a capacity of 56,000 pounds of steam per hour, and to maintain a vacuum equivalent to an absolute pressure of 1.5 pounds per square inch with the inlet temperature of the condensing water 82 degrees F. The annual charge for interest, depreciation, repairs, maintenance, taxes and insurance has been taken at 15 per cent. of the initial cost. The circulating pump is assumed to be of the centrifugal type, driven by an electric motor, and the cost of energy is taken at ¾d. per hydraulic horse power hour. The results would not be greatly affected, however, if the electric motor were replaced by a steam engine, provided the cost of steam were equivalent to ¾d. per hydraulic horse power hour. In all the

figures here presented, the ordinates indicate the annual charge, which takes into account the interest, depreciation, maintenance, etc., on the first cost of

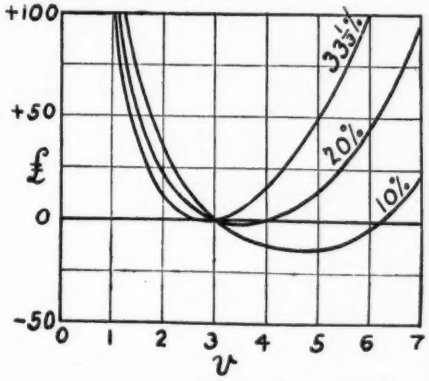


FIG. 2. NO EXTERNAL HEAD. $\delta = 11$. IN SECOND SERIES EXTERNAL HEAD = 35 FEET.

condenser, pump and motor, and the cost of energy to drive the pump. Instead of the total charge, however, the ordinates show only the difference between the charge under the particular conditions and the charge under standard conditions. These standard conditions give to δ a value of 11, to v a value of 3, and to W, p and t_1 the values stated above;

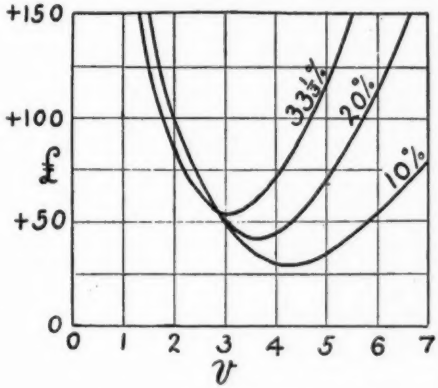


FIG. 3. NO EXTERNAL HEAD. $\delta = 4$.

in Figures 1, 2 and 3 the external head is assumed to be zero, and in Figures 4, 5 and 6, and also in Figure 2 when this is used in the second series, an external head of 35 feet is assumed.

The values of δ and Q in Figures 1, 2 and 3 are, respectively, 20 and 4,000,000*, 11 and 2,435,000, and 4 and 1,866,667. In each case, plant load factors of 10, 20 and 33 1/3 per cent. have been assumed. It is apparent from Figures 1, 2 and 3 that the best velocity depends to a certain extent on δ, and to a greater extent on the plant load factor, but in no case is it less than 2¾ feet or more than 5 feet per second.

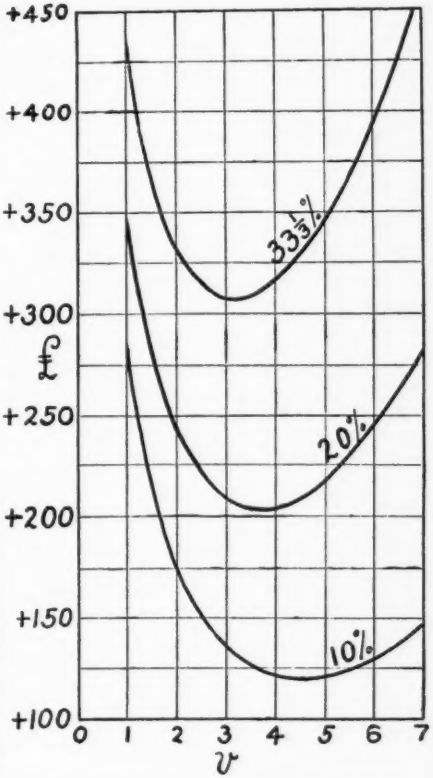


FIG. 4. EXTERNAL HEAD = 35 FEET. $\delta = 20$.

The conditions in the cases represented by Figures 4 and 5 are the same as those in Figures 1 and 3, except that a cooling tower is included which adds an external head of 35 feet to the frictional head within the condenser. Figure 6 is of the same nature as 4 and 5, but with δ equal to zero and Q equal to 1,648,000. As the ordinates in all the

* For the method of calculating Q see the review of Mr. Neilson's article in our issue for September.

figures represent only differences from the values under standard conditions and since these standard conditions are represented in Figure 2, this figure serves whether or not there is a cooling tower and an external head. Figures 4, 2, 5 and 6, therefore, in this order, constitute a series in which δ is progressively decreased and Q progressively increased. The cooling tower and external head make a great difference in the total annual charge, but make no difference in the best velocity to employ in the condenser tubes. It will be seen that in the second series, the best velocity is never below 2¾ feet or above 5 feet per second.

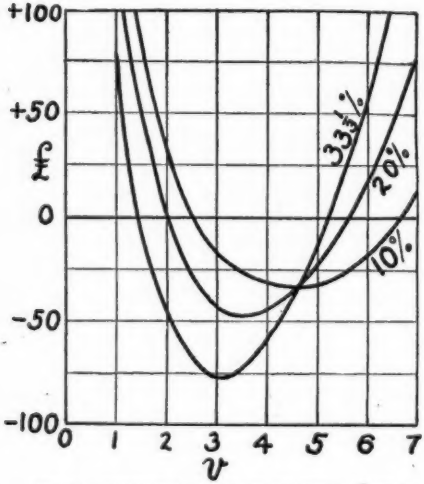


FIG. 5. EXTERNAL HEAD = 35 FEET. $\delta = 4$.

A further series of curves, designed to show the effect of varying charges for energy on the best velocity, is given by Mr. Neilson. These curves are drawn to represent cases in which the cost of energy is, respectively, ½d., 1d., and 1½d. per hydraulic horse power hour, the other conditions being standard. They apply whether there is an external head in addition to the frictional head within the condenser or not. Figure 2, representing a case in which the cost of eneregy is ¾d. per hydraulic horse power hour, forms with these three curves a connected series. With energy at ½d. per unit, the best velocity varies from about 3½ feet per second to 4¾ feet per second. With higher charges for energy, the best velocity varies less; and with a charge of 1½d. per hydraulic horse power hour, the best velocity is never far removed from 3 feet per second within the range of load factors considered.

In all the curves only one vacuum and one inlet temperature of the circulating water have been considered. The curves would be little changed for other vacua if the inlet temperature of the circulating water were increased or reduced by an amount equal to the increase or reduction in the temperature corresponding to the vacuum. Mr. Neilson shows also by means of a diagram that the best velocity in cases where only a moderate vacuum has to be maintained with low temperature of circulating water is still within the limits shown in the diagrams. These limits apply also to the conditions usually met in steamships.

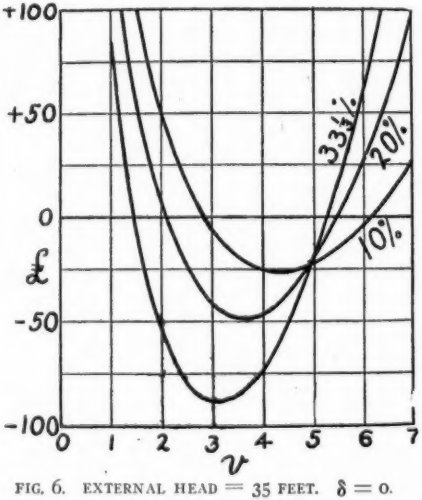


FIG. 6. EXTERNAL HEAD = 35 FEET. $\delta = 0$.

"Much has been done in recent years," Mr. Neilson concludes, "in attempting to reduce the necessary cooling surface in condensers. Sometimes success has been attained by improvements in design without altering the water velocity, the results being in every way good. In other cases the reduction in surface has been wholly or partly attained by increasing the water velocity. Where the velocity was previously unduly low, the

change in design has been beneficial; but in many cases, in order to obtain great reduction in surface, the increase in velocity has been pushed too far.

"When it came to be generally recognized that turbines benefited greatly by a high vacuum, there was a tendency to push the vacuum too far till the increase in the cost of obtaining the vacuum was greater than the increase in the benefit derived from it. So with condensers and water velocity; in many cases the velocity has been made too great, till the cost of the increase in the velocity is greater than the benefits derived from the increase. The question, in fact, has not received the consideration which it deserves."

THE STEAM TURBINE IN GERMANY.

A DISCUSSION OF THE GROWING TENDENCY TO MERGE THE DIFFERENT SYSTEMS INTO ONE STANDARD TYPE.

F. E. Junge and E. Heinrich—Power.

BOTH in America and in Europe the most important of recent developments in steam-turbine design seem to be in the direction of the evolution of a general standard type embodying the best features of all existing systems. The merging of systems has progressed less rapidly in America than it has in Europe, but the tendency towards standardization is already well marked. Thus, for some of the Westinghouse turbines, the American representatives of the Parsons type, the double-runner velocity stage of the Curtis system has been adopted for the initial expansion, while it is reported that the General Electric Company, the builders of the Curtis turbine, have built some units in which the Parsons system is used for the final stages.

The progress of standardization in Germany, where it is perhaps most apparent, is described by F. E. Junge and E. Heinrich in *Power* for November 8. "It is an acknowledged fact that the development of steam-turbine construction, after having acquired a high degree of thermal excellence, tends now toward a standardization of the different systems, which at present are dominated and characterized by a few simple principles of steam flow and structure. The following discussion of these principles will be confined merely to axial turbines, because the radial turbine has not so far shown an equal capability of development, at least for purposes of large-scale power production.

"First. The many-stage reaction principle developed by C. A. Parsons. As regards the utilization of steam energy this system is characterized by the fact that the conversion of the potential energy of the steam into kinetic energy takes place not only in the guide-blade channels, but also in those of the rotating part. Regarding construction, the Parsons system is characterized by the use of a drum with dummy pistons and labyrinth packing.

"Second. The many-stage action principle with one row of blades on each rotating wheel, developed by Rateau and modified by Zoelly. As regards the utilization of steam energy this system is characterized by the fact that the conversion of the potential steam energy into kinetic energy takes place in the guiding apparatus only, while the whole kinetic energy of a stage is utilized in a single row of rotating blades. Regarding construction, the Rateau-Zoelly system is characterized by the employment of several disk wheels and by the separation of the different stages through guide-wheel disks, which reach unto the hubs of the rotating wheels.

"Third. The many-stage action principle with velocity staging developed by Curtis. As regards the utilization of steam energy, this system is characterized by the fact that the whole potential energy of one stage is, as a rule, transposed into kinetic energy in expanding nozzles, and further, that the kinetic energy of each stage is utilized in several rows of revolving blades. Regarding construction, the Curtis system possesses rotating disk wheels, like No. 2, but fewer in number, which are equipped with several rows of blades; in addition,

it possesses deviating blades which are fixed in the casing.

"The principle of one-stage action has not been included in the above. This system, as developed by De Laval, shows in its practical execution several remarkable solutions; for instance, the flexible shaft and the disk wheel with high peripheral velocity. But the very nature of the De Laval turbine, at least in its original form, militates against the attainment of high capacities. The high peripheral velocity and the resulting high number of revolutions necessitate the employment of gears in order to get down to practicable speeds. Gears for high output have not, however, found favor in stationary practice. In the Riedler-Stumpf turbine the attempt was made to attain reasonable speeds by adopting very large wheel diameters and best material. But practice has evinced that buckets milled into the rim of the wheel would not stand the eroding action of the steam jet, and that the steam consumption increased very materially owing to the destruction of the sharp admission edges of the buckets.

"The three above-mentioned fundamental principles of steam-turbine construction have developed each for itself in Germany. Gradually, however, there has been a fusion of the different systems. For example, the A. E. G. has abandoned the Curtis construction of the low-pressure part of its 1,500 revolutions per minute type and has adopted the principle of many-stage action as developed by Rateau and Zoelly. Up to this year the pure Curtis principle was followed in its 3,000 revolutions per minute type, showing two pressure stages with two velocity stages each. The best known type of this class is the turbine of 1,000-kilowatt capacity. But for outputs beyond 1,000 kilowatts the A. E. G. now builds the low-pressure part after the Rateau-Zoelly principle. Evidently the cost of construction of the said type of 3,000 revolutions per minute, which contains only two rotating wheels with two rows of buckets each and only one guide-wheel disk, is lower than the cost of a turbine of equal output which contains, besides a rotating wheel with two rows of buckets, from five to seven wheels with one row of buckets and the same number of guide-wheel disks. But the severe demand for a low steam-consumption guarantee, which would enable the firm successfully to compete with other German makes, forced the designer to adopt a somewhat more expensive construction. The Bergmann Electric Works build their turbine similarly, using a combination of the Curtis and Rateau principles.

"Even the foremost of the German firms representing the Parsons interests, Brown, Boveri & Co., have, after long hesitation, resolved to follow the example of other builders of reaction turbines. They have replaced the high-pressure stages of the Parsons turbine by a Curtis wheel, reducing the length and weight of the unit enormously. Only for large units and special-service conditions is the pure Parsons principle maintained. Last, but not least, the Curtis principle begins to intrude into the Zoelly syndicate, which, so far, has resisted with tenacity all attempts to change its original mode of construction. The Augsburg Nürnberg Works, members of the syndicate, have just begun to build all of their 3,000 revolutions per minute types on a combination principle, using the Curtis and Zoelly features. The Görlitz Machine Works, licensees of Zoelly, have also built normal types of turbines in accordance with the above principle, but only for sizes below 700 kilowatts. The other members and licensees of the Zoelly syndicate have not adopted the new practice.

"Summing up it may be said that turbine construction tends toward the creation of a standard system of unity, which will include all of the best features of the different types. In the present stage of development the following variations exist: First, the combined Curtis and Rateau system; second, the combined Curtis and Parsons system; third, the pure Rateau-Zoelly system; fourth, the pure Parsons system; fifth, the pure Curtis system. The above order of importance has been arranged according to the influence which, in our notion, the various systems exercise upon the art of turbine building for stationary purposes in Germany to-day.

THE PHILOSOPHY OF PROCESS INVENTIONS.

A CRITICISM OF THE ATTITUDE OF THE COURTS OF THE UNITED STATES ON THE PATENTABILITY OF PROCESS INVENTIONS.

E. D. Sewall—Machinery.

THE laws of the United States provide for the grant of a patent to any one who has invented a new and useful art, machine, manufacture, or composition of matter. No doubt ever arises as to the patentability of new and useful machines, manufactures and compositions of matter; these are concrete things, cognizable by both the senses and the intellect. With respect to art or process inventions, however, the most fundamental doubts in the law of patents arise. Judicial interpellation indicates that process inventions whose results can be apprehended only through the intellect are not patentable, while those that produce a change in the condition of matter that is perceptible to the senses may be patentable. Even when process inventions clearly relate to the useful arts within the provision of the constitution, the greatest uncertainty has prevailed throughout the history of patent law, not only in the United States but in European countries also.

The status of process inventions is examined by E. D. Sewall in an interesting article contributed to *Machinery* for September. In the brief abstract of this paper following, we are obliged to confine our review to Mr. Sewall's summary of the philosophy of process inventions, omitting his illustrative citations of court decisions in the United States and England. "The phrases 'mechanical process' and 'function of the machine,'" says Mr. Sewall, "have been disastrous to many a valuable invention. It has been enough to say that a process is merely 'manipulative,' involving 'no chemical or other elemental action,' to deny its patentability.

"The prejudices against mechanical or manuipulative processes have about the same kind of vague foundations as popular superstitions. . . . . Three classes of inventions corresponding exactly with the intellectual laws of invention have always been expressly recognized in the United States statutes. These three classes are (1) the product or thing produced—represented by the words 'manufacture' and 'composition of matter,' (2) the way or method of producing the product, or of accomplishing an industrial effect (when the product of the process is not a concrete thing, as a form of energy), represented by the word 'art,' (3) the instrument used to aid in practicing the 'art,' represented by the word 'machine.'

"The order of inventive conception is (1) the product, (2) the process of making the product, (3) the machine for carrying out the process. In answer to the question, 'What shall I make?' the inventor conceives the product; to the question, 'How shall I make it?' he conceives the process; to the question, 'By what means shall I practice the process?' he conceives the machine. He must have a clear notion of a product before he can devise a process of making it and must perceive clearly the process before he can build a machine to practice that process. Patents rank in value in the same order. The patent for a manufacture gives the broadest possible protection, since subject to it are all possible processes of making it. The next broadest protection is afforded by the process patent, since subject to it are all possible machines whose *modus operandi* is the process. The protection afforded by the apparatus or machine is the most limited of all. Of course a machine or apparatus may be the product desired, and the process of making that machine will then be inferior in patent value to the machine. Or the ultimate result may be an effect, not resulting in a manufacture, produced by a process carried out by the aid of a product which in turn becomes an instrument inferior in value to the process. But always, in the relation of value and rank, the process is higher than the instrument used in practicing it, and the product is higher than the process by which it is made.

"Higher still than any of the three kinds of inventions—product, process, and apapratus—stand effect, result, principle, which are not inventions. In accordance with natural law and with the fundamental principles governing monopolies, principle, result, effect, cannot be monopolized. They are the property of all equally, and become known by perception, not by invention. There can be no lawful claim for an effect or principle. A claim in a patent or application for patent for an invention in any one of the three statutory classes conclusively concedes pre-knowledge of that which stands higher in rank. A claim for a product concedes pre-knowledge of the mode of using it and of the effect or results designed to be produced by its use; a claim for a process conclusively concedes pre-knowledge of the principles utilized in the process, of the product made by that process; and of all instruments the use of which is made a part of the process; a claim for an apparatus concedes previous knowledge of the process it is designed to practice.

"The principles just stated are fundamental and essential to be applied in testing any alleged invention. It must also be remembered that all invention lies in the mental conception. For obvious reasons the invention is not a patentable one until it has been made potentially available to the public. But in testing any claim for the presence or absence of invention, the inventive conception must be resorted to and the rank of that conception determined. . . . . .

"No valid product patent can be so broad in scope as to prevent the possible allowance of other non-infringing product patents designed to secure the same effect. No valid process patent can be so broad as to hold as an infringement every other possible process patent for producing the same product. No valid machine patent can be of such scope as to close the field to other machines for carrying out the same process. By 'possible' is here meant theoretically possible, as it may occur, as in the telephone invention, that the method discovered and applied is the only one. This is a fundamental truth of patent law, notwithstanding that the existing mass of patents granted fail to support it.

"Process inventions are in general the most fundamental ones. They *are* the 'useful arts.' The most valuable manufactures have been known and used for years; and as ways of manufacturing essentially old products are the prime problems of manufacturing industries, it is most important to have process inventions protected.

"A process is a way of attaining a result; and any process that is new, useful, and based on an inventive conception, is patentable under the law, if it is applied to 'science and the useful arts.' It matters not whether or not it includes 'chemical' reaction or 'similar elemental action,' or is carried out by an automatic machine. The only conditions precedent imposed by the law are that it shall be new, useful, and an invention; and those conditions apply equally to all classes of invention.

"The much discussed and much applied phrases 'function of a machine,' 'mere mechanical process,' should be dropped from consideration in determining the patentability of a process. They have no bearing on the question of invention involved. Process inventions should be approached in the same way as machine or article inventions.

"In settling whether a defined process is patentable it must, of course, be determined that it is within the field of permissible monopolies, and if it is, then it must be ascertained, (1) if it is new, (2) if it is useful, (3) if it is an invention—nothing else. The question of utility presents little difficulty and that of novelty, none, except research into the existing art. The serious question is that of invention. In settling this, most of the negative rules applicable to machine inventions are applicable to processes, and there is no more mystery connected with the treatment of process than with the treatment of machine inventions. If the process alleged is an 'aggregation' of separate processes, if it involves over an old process the mere substitution of an equivalent step, it is not patentable.

"The word 'mystery' was frequently applied to processes in the early days of

patent monopolies. The word aptly indicates the essential quality of a patentable process. To be patentable a process must be mysterious to one who has not been informed. No process that is not mysterious, that does not include hidden steps, no process that is apparent when the result of it, or the principle involved in its practice, is considered, is patentable.

"Chemical processes have been uniformly admitted patentable. What are the 'similar elemental actions' that render process inventions patentable? Can anyone conceive of any acts performed on matter, gaseous, liquid, or solid, that do not take advantage of some elemental law of nature? One hammers iron into a nail, taking advantage of the laws of cohesion and malleability. One sifts ashes aided by the law of gravity, one folds paper, taking advantage of the property of flexibility. But whether elemental action is involved or not is wholly immaterial; such action probably always is involved. The sole thing to be considered is whether there is a 'mystery' which this process has unraveled.

"Every machine and every instrument operates to practice some process in whole or in part. The fact that that process is ancient and common makes it none the less a process. The process of smoothing wood by planing, or shaping iron by hammering, is still a process under the patent laws, although an ancient one. A process that is carried out by an automatic machine may be no less an invention than one carried out by hand or by chemical reagents. . . . . .

"The question is always one of invention. Some things cannot be done by hand. Gases cannot be confined without instrumentalities, and metals cannot be shaped by the fingers. Instruments are usually necessary to the practice of processes. A claim for a process practiced by a particular instrument as a rule does not define the real invention; but it is conceivable that the use of a particular instrumentality for practicing a process may be of the essence of the invention, or that a new process may be devised for operating an old machine. Denial of validity of process inventions by allegations that they are the mere functions of a machine would better give place to treatment by considering the novelty and utility in the abstract process or series of steps as a mental conception divested from any instrumentalities, and then, presuming the abstract process to be disclaimed, considering whether there was any invention in selecting the stated instruments to aid in practicing it."

BAROMETRIC PRESSURE AND LIBERATION OF FIREDAMP.

A THEORY OF THE RELATION BETWEEN LIBERATION OF FIREDAMP IN COAL MINES AND BAROMETRIC PRESSURE, BASED ON EXPERIMENTS AT LIÉVIN, FRANCE.

Léon Morin—Annales des Mines.

MINING engineers are not yet agreed on the theory of gas liberation in coal mines which attributes to barometric pressure an important influence on the rapidity with which firedamp escapes into the atmosphere. There is no lack of evidence, however, of the fundamental validity of the theory. Galloway, who investigated the question for the British Royal Commission on Accidents in Mines, noted the importance of observing barometric changes, and on his recommendation a rule covering this point was inserted in the Mines Regulation Act. In Germany, the experiments of Schondorff and Nasse in 1875 and 1877 established the danger to be apprehended during periods of low pressure, especially in mines comprising large areas of old workings. While the French Commission of 1880 questioned the influence of atmospheric pressure, Le Chatelier agreed that worked-out areas would be more susceptible than new workings. Five years later the theory was firmly established by Koehler's well known researches at the Karwin mines in Westralia, and additional confirmation was given by Chesneau in 1886. In later years the theory has been widely accepted as an explanation of the cause of mine ex-

plosions, F. Laur, for example, in 1907, attributing the disasters at Reden, Liévin, Charleston and Fayetteville to the period of depression preceding each explosion.

The latest investigation of the question, and perhaps the most scientific ever made, is that of Léon Morin, whose report, originally published in *Annales des Mines,* is abstracted in the *Engineering and Mining Journal* for September 17. M. Morin's experiments, which extended over a period of two months, were made at four upcast shafts at Liévin, France, each of which had a large tributary area of worked-out ground. At one of these, Shaft No. 13 of the Du Souiche du Levant mine, the percentage of gas was determined every hour, except on Sundays, and at the other three, every eight hours. The Du Souiche shaft was used only as a upcast air shaft, and it was found that the volume of air circulating in the mines was almost perfectly uniform. The area circumscribed by the air current was 166,000 square metres. Except for a small working 12 metres below, the seams above and below the Du Souiche were untouched coal.

Every precaution was taken to secure accuracy in taking the hourly samples. At the beginning of the experiment, simultaneous samples were taken near the roof, near the middle, and at the floor, but it was found that the three samples were identical in composition, owing no doubt to the mixing of the air by the high velocity of the air current. The analyses were made by means of Coquillion apparatus as modified by Le Chatelier, which were frequently calibrated and checked by the use of the Le Breton device. Here too every possible precaution to secure accuracy was observed. Barometric observations were made at the surface only, a method proved by Koehler to be permissible, by means of a recording aneroid, which was compared daily with a mercury barometer.

An inspection of the curves plotted from the data recorded during the experiments warrants the following conclusions: "(1) even slight variations in atmospheric pressure induce variations in the escape of firedamp; other things being equal, while atmospheric pressure remains constant, the liberation of firedamp is equally uniform; (2) when atmospheric pressure increases, the escape of gas diminishes, and conversely; (3) maximum atmospheric pressure corresponds with minimum percentage of gas, and *vice versa;* (4) the variations in percentage of gas may reach great importance; thus, a fall of from 770 to 740 millimetres in the barometer increases the proportion of methane by 50 per cent.; and (5) there is no exception to the general rule of inverse ratio between variation in pressure and variation in percentage of gas.

"The first explanation of the phenomena that occurs to one is that the empty spaces in the old working places of the mine constitute a kind of reservoir for the firedamp, absorbing it when the atmospheric pressure is high, and liberating it again when the pressure falls. It is obvious that the old workings of a coal mine do contain numerous voids, in crevices, in rooms incompletely gobbed, and in the gob itself. If the settling of the surface followed closely after the exhaustion of the coal, the percentage of voids in the old workings would be smaller, but this settling is not complete, usually, depending upon the nature and thickness of the strata, the supporting power of the waste filling, the timbering, and other factors. The closure of the voids is never perfect, even after the surface has settled as much as it will."

This theory M. Morin has found to be untenable. Experiments made to determine the character of the air contained in old workings showed that it was impossible to secure from old workings samples of air rich in gas, even when the sampling pipes were located close to the roof and at one of the highest places of the mine. The tests indicated that while the exhalations from old workings, no matter how carefully packed, may contribute gas to the ventilating current of adjacent operations, they do so to only an unimportant degree. Old workings are, therefore, not the only, nor even the most important, cause of variation in the percentage of

firedamp liberated by a given coal mine. A sufficient explanation for the phenomena must be sought in the original source of the gas.

The principal sources of firedamp in coal mines are the unbroken coal at the breasts of working places, freshly broken coal, and the rock strata adjacent to the coal seam. M. Morin has investigated the relative importance of these sources of contamination. In the case of massive, unbroken coal, the results indicate that the permeability of massive coal, in a seam so situated as to drain itself of gas, increases slowly at first, and then much more rapidly as soon as the drainage becomes well established. From freshly broken coal, results were obtained showing a richness in gas exceeding the explosive proportion; it is apparent, therefore, that coal thrown into the gob, as well as the carbonaceous rocks in floor and roof, continue to evolve gas after the working face has passed on. As to the gas exhaled from rocky strata, M. Morin's tests showed that the floor and the roof of a coal seam contain gas which they gradually relinquish after the period of active work has passed. At a distance from the seam, however, the percentage of gas in the barren rocks becomes very minute, except as it may be transmitted there through fissures leading from other sources.

Turning now to the effect of barometric pressure on the liberation of gas from these original sources, M. Morin has been unable to discover that the volume of gas exhaled by the solid coal in working faces shows any variation corresponding to fluctuations in barometric pressure. As for coal and carbonaceous rock in the mine filling, the gas which they contain is probably dissipated in a comparatively short time, and does not greatly affect the subsequent fluctuations in the percentage of gas observed in the ventilating current. M. Morin believes, therefore, that barometric changes affect mainly the quantity of gas liberated by the floor and roof of the seam under operation, whether this gas is contained in the rocks themselves or comes through fissures from adjacent seams.

"The gaseous zone above and below the seam under development," he says, "retreats as work in the seam advances; as the coal is removed the roof settles and the floor tends to rise, causing fractures through which the gas of adjoining virgin seams enters the workings. A solid seam is comparatively impervious to the passage of gas. The pressure that actuates a flow of gas through the fractured zone is, therefore, entirely independent of the original pressure existing in the neighboring seams in their undisturbed condition. The barometric variations, always of relatively small magnitude, are not, then, pitted against the pressure of kilograms, as it exists in solid seams, and are, therefore, able to influence the flow of gas from this fissured zone to the degree which we have observed.

"As the drainage of gas from the fractured region becomes more complete, the pressure becomes more and more feeble, thus permitting the barometric variations to exert a more and more pronounced influence upon the outflow. Thus, in addition to the normal flow of gas under high pressure from the working face and from the newly formed fissures close to the working face, we can readily imagine an outpouring of gas through floor and roof, copious though under low pressure, the volume of which will be proportional to the area of the old workings of the mine. This, I believe, is the source of gas, most susceptible to barometric changes, that is responsible for the tremendous observed variations in the quantity of firedamp liberated by a given coal mine.

"On this supposition, it is easy to interpret the results of our experiments in the Du Souiche seam. The quantity of liberated gas does not depend alone on the magnitude of the fluctuation in pressure, but also on the absolute barometric reading at each moment, becoming thereby proportional to the length of time elapsed between the two extreme pressures defining the fluctuation. On this ground, also, we can explain the disproportionate values found by computing the volume of voids in the old workings; neither are we compelled to

assume that these voids are filled with pure methane, an assumption not borne out by our observations. . . . . .

"As a means of discounting the effect of fluctuations in pressure upon the outflow of gas in a mine, it has generally been suggested that the ventilating fan should be driven faster during periods of low pressure, but it is equally important that the speed should be reduced whenever the pressure is high. This is a delicate means of adjustment, especially if some form of electric motor, the speed of which is so easily regulated, be used to drive the fan. It should be remarked, however, that any attempt to attain complete uniformity of gas percentage in the air from a whole mine would require abnormal and impracticable regulation of the motor speed, but any mechanical device helping to increase the supply of air during periods of low barometric pressure should be considered a distinct step in advance.

"In this connection it may be of interest to outline the use that may be made of hooded ventilators for utilizing the power of the winds produced by the very barometric changes that we are trying to circumvent. These hoods can be supplied to both downcast and upcast shaft, assisting the power of the mechanical ventilator by the amount of their combined effort. From data as to wind velocities, air densities, and other factors, collected in the vicinity of our mines, we have computed that a wind having a velocity greater by 10 metres per second than that of the current down the air shaft produces a motive force equivalent to 27 millimetres of water. Our normal fan pressure during the summer is 45 millimetres of water, for the exhaustion of 77 cubic metres per second, which, in winter, becomes 25 millimetres, with an output of 102 cubic metres. I strongly recommend the use of these hoods, wherever feasible, as an adjunct to mechanical ventilators."

A MODIFICATION OF THE CYANIDE PROCESS.

A BRIEF SUMMARY OF THE CLAIMS OF THE CLANCY PROCESS, WHICH EMPLOYS CALCIUM CYANAMIDE AND ELECTROLYSIS.

Metallurgical and Chemical Engineering.

THE modified cyanide process suggested by John C. Clancy is one of the most interesting, and, if the claims of the inventor are substantiated in practice, one of the most important, of recent metallurgical inventions. The point of most interest is that Mr. Clancy proposes to substitute calcium cyanamide, which is now very cheaply produced electrically by the fixation of atmospheric nitrogen by means of calcium carbide, for part or all of the sodium cyanide or potassium cyanide now used. If this substitution can be made, it will mean a considerable saving in the cost of recovering the precious metals. The process is complicated by the necessity of employing electrolytic action, but the electrolytic apparatus is so simple in construction that its maintenance is not likely to add substantially to the operating costs.

In the November issue of *Metallurgical and Chemical Engineering* is printed a long extract from a foreign patent specification written by Mr. Clancy, which describes the process in detail and gives a large number of examples of the method of treating ores of different compositions. The following paragraphs summarize Mr. Clancy's claims and give a brief outline of the chemistry of the new process. "I have discovered," says the inventor, "that a cyanogen-bearing compound which is not a solvent of the precious metals can be made a solvent of the same by the addition of an amidine or amide compound in the presence of an electric current. As a result of this discovery I am able to use cyanogen compounds, heretofore not available in the cyanide process, and also I am able to regenerate spent cyanide solutions, and I am also able to use in the cyanide process oxidizing agents without loss of available cyanide.

"I have also discovered that when the pulverized ore is converted into a pulp

by mixing the said ore with a substantially non-acid solution of a thiocyanate containing a halogen salt, and electrolyzing this mixture, then the precious metals only will be dissolved to the substantial exclusion of the baser metals, and that the above solution may be used with advantage in conjunction with the ordinary cyanide solution, and that this process may be successfully applied to either rebellious or non-rebellious ore without preliminary roasting, even though such ores contain reducing agents or tellurium or both.

"In the practice of my invention I may use the crude cyanamide of commerce, its isomerides and polymerides, as a solvent for the precious metals and other metals contained in ores; or I may use a soluble cyanamide in conjunction with the cyanide process in the treatment of ores, and as a means of regenerating cyanide solution or non-available cyanogen-bearing solution.

"When a soluble amidine or amide compound (such, for example, as dicyandiamidine, urea, guanidine, guanidylgluanidine, guanidine carbonate, formamide, oxamide, cyanamide, dicyanamide, or the various polymeric and isomeric modifications of the last-mentioned compounds) is added to a cyanogen-bearing solution and the mixture electrolyzed in contact with ore, the consumption of cyanide is very strikingly reduced; and also solutions containing cyanates, before, after or during the treatment of ore (together with ferrocyanides, ferricyanides, thiocyanates, or other such non-available cyanogen compounds formed in the treatment of ores) may be converted into compounds which readily dissolve the precious metals contained in ores; and most remarkable is the regeneration of cyanide from cyanates, such as alkaline cyanates, isocyanates and the various isomeric and polymeric compounds, or the oxygen derivatives of cyanogen, their isomerides and polymerides.

"I have described the addition of a soluble amidine or amide compound, which may also include any of the above-mentioned compounds; but I use preferably, when working my process, a soluble cyanamide (such, for example, as calcium cyanamide, as it is at present the cheapest source of an amidine or amide compound). A solution of calcium cyanamide, or its isomerides and polymerides, when subjected to electrolysis, is, I have discovered, capable of dissolving the precious metals, and other metals, without any other admixture of cyanogen-bearing material. From cyanamide all the amide or amidogen compounds I have mentioned are very easily prepared. . . . . .

"To show the action of these amide compounds I may take, for example, urea (carbamide) and add this to a solution of a cyanate (such, for example, as potassium cyanate) and electrolyze this mixture between inert electrodes. After a few minutes the said mixture will be transformed into one which will dissolve the precious metal in alkaline solution. It is well known that cyanates have absolutely no dissolving effect upon the precious metals, and that the formation of cyanates in the cyanide solution represents the chief source of loss of cyanide in the cyanide process, since when cyanates are allowed to stand for any considerable time, or are retained in solution, they are converted into ammonia and potassium carbonates and are transposed by the lime used in the cyanide process into insoluble carbonates, or by the action of sulphuric acid in the ore into sulphates, so that the original cyanide finds itself eventually in the residue dumps in the form of calcium sulphates or insoluble carbonates. Any oxidation means, when used in the cyanide solution to hasten the dissolution of the precious metals, increases the cyanide consumption, due to the formation of cyanate, which is often very great; and up to the present no means for regeneration or recovery of cyanide from cyanate in aqueous solutions has ever been discovered, so far as I am aware; but by my discovery that a soluble amidine or amide compound (such, for example, as calcium cyanamide) added to the cyanide-bearing solution, in conjunction with the electrolysis of said solution, opens up a cheap way whereby oxidation means other than atmospheric oxygen (such as treatment of cyanide-bearing solutions with oxidizing agents and soluble halo-

gen compounds, or other oxidation means) may be successfully employed for readily dissolving and extracting precious metals from refractory ores, such as tellurides, arsenides, sulphides and other ores containing reducing agents. In general, this process may be successfully applied to either rebellious or non-rebellious ores without preliminary roasting, even though such ores contain the refractory compounds mentioned.

"The apparatus for carrying my process into effect is simply the ordinary agitating tank furnished with electrodes spaced about from 1½ inches to 2 inches apart. These electrodes may be made of carbon, or one of iron and another of carbon; that is to say, the positive electrode undergoes no deterioration, as only nascent hydrogen is produced at the said electrode; therefore, iron answers the purpose. The negative electrode or anode is made preferably of a hard graphite or other such inert material. The circulation caused by the agitation keeps the whole mixture constantly circulating between the said electrodes. This circulation is maintained for a period of from 8 to 12 hours to obtain the desired results." The consumption of electrical energy, in the examples cited ed by Mr. Clancy, is about 90 to 120 amperes per ton of ore."

THE CONTROL OF MOTORMEN BY CAR METERS.

A REVIEW OF THE RESULTS OBTAINED IN EUROPE BY THE USE OF CAR METERS ON TRAMWAYS.

G. Bouton, M. Battes—Union Internationale de Tramways.

REPLIES received by the Union Internationale de Tramways et de Chemins de Fer d'Intérêt Local in response to a *questionnaire* sent out to the members indicate that the use of car meters as a means of controlling motormen is rapidly increasing in popularity among the managements of European tramways. In 1906 only ten tramways had adopted the use of car meters. By 1908 the number had risen to 26. It was reported at the recent biennial meeting of the Union that 37 tramways have definitely adopted this method of controlling their motormen, twelve are carrying on tests towards this end, while three have finally renounced the use of car meters.

A summary report on the replies to the *questionnaire,* prepared by M. G. Bouton, general manager of the East Paris Tramways, is abstracted in *The Electrician* for October 7. In M. Bouton's opinion, the question which has to be solved to-day is not so much whether it is advantageous or not to control the work of motormen by means of meters, but to choose between the different methods of applying this principle, between the apparatus and the method of using the results which are obtained. The two points of view from which the question can be considered, while apparently diverse, are in reality quite closely connected. The proper solution of the problem differs from undertaking to undertaking, and is affected by many factors. In exceptional cases, facilities for efficient supervision, low power consumption, and cheap power may create conditions in which control by means of meters would be of little use. When the undertaking does not come within this class of exceptional cases, a choice must be made among the various instruments, with a view to securing the utmost possible regularity of readings. There are now three types of car meters, each of which has its advantages and disadvantages; but as these advantages and disadvantages are of different kinds, each system may be best accommodated with one particular type of meter.

"Clock meters, although very simple, do not measure what one is trying to obtain, *i. e.,* the energy consumption of the car. Partisans of clock meters recognise in principle that this reproach is well founded, but they consider that in practice the indications which are obtained are just as good as those obtained from wattmeters in allowing an efficient control over the motormen. They further state that the question is more complex

TABLE I. FIRST AND OPERATING COSTS.

Type of meter	Watt.	Ampere-Hour.	Clock.
First cost:			
Lowest	£3 14s.	£4 5s.	£1 14s.
Highest	£9	£5 12s.	£5 4s.
Average	£5 8s.	£4 16s.	£2
Per car mile	0.007d.	0.006d.	0.003d.
Running expenses per car mile:			
Lowest	0.002d.	0.002d.	0d.
Highest	0.005d.	0.005d.	0.001d.
Average	0.003d.	0.003d.	0.0005d.
Administrative expenses per car mile:			
Lowest	0.004d.	0.004d.	0.0002d.
Highest	0.05d.	0.05d.	0.0009d.
Average	0.01d.	0.01d.	0.0004d.
Total expenses per car mile	0.02d.	0.019d.	0.004d.

than simply determining the energy consumption; that what the manager requires to know is the greater or less skill of each motorman in expending only the minimum of energy possible in producing a certain amount of useful work. This work produced, which appears under the very simple form of a certain service effected, is in reality so complex that it is not possible rigorously to measure it. Allowing that its intrinsic value depends on a certain number of factors, some of which are of an essentially variable nature, such as the efficiency of the gearing, the atmospheric conditions, the number of passengers, the traffic on the routes, and the knowledge of the motorman, they consider that whatever type of meter is employed there must exist the same and rigorous proportion between each of the readings and the skill of each of the motormen whose work is judged by these readings."

With this view M. Bouton is not in sympathy, and in opposition to it he quotes results of tests on various lines which show a complete lack of concord between the records furnished by clock meters and by ampere-hour meters or wattmeters. "The results of these tests further indicate that with the clock meter the skill of the motorman is measured by means of a unit—the time the car is under current—whose value, compared with the quantity of energy consumed, is susceptible of very great variation according to the way the car is operated. In consequence, the readings of the clock meter are not sufficient by themselves to determine the skill of the motorman. These indications can only be of real use when very close control causes the motorman to work in a uniform manner according to the rules which have been laid down. This is only realized with difficulty, especially on lines in traffic, or else under the condition which is very seldom fulfilled of possessing a *personnel* which is sufficiently conscientious to follow the instructions which are given, without any inspector being necessary."

Of the other two types of meter in use, the wattmeter and the ampere-hour meter, "the first is most complete, as it makes a true comparison, in which each motorman in each car possesses a certain rank in accordance with the energy consumption. It is more complex, however, and more costly than the second, which consists simply of the classification on the 'dossier' of each motorman, and on the way bills, of the readings given by the meters, and the average time during which a car is under current for the service it has undertaken. The first allows a proper classification of the motormen to be obtained, while the second simply points out those who are working in a reprehensible manner."

Data of first and operating costs of the different types of meters are summarized in the table following. In each case the life of the instrument is assumed to be 187,500 car miles.

"In a general way it is recommended that the work of motormen as regards energy consumption should be controlled by means of meters. This control is only truly efficient when each car is fitted with a meter. The application of the control can be effected in two ways: In the first, with a view to ensuring that the individual motorman consumes the lowest amount of energy compatible with the necessities of the service, an influence is exerted on the *personnel* by dis-

TABLE 2. SAVINGS EFFECTED BY THE USE OF CAR METERS.

Place.	Type of Meter.	Number of Meters Installed.	First Cost per Meter.	Economy of Energy, per cent.	Annual Saving.
Amsterdam	Clock.[a]	235	£2 4s.	11.5	.....
Berlin	"	1,491	£2 [b]	7.8	£21,344
Berne	"	41	.....	10 [c]	.....
Cologne	"	410	£2 1s.[d]	8.6	£45,000
Düsseldorf	"	All cars.	£1 15s.[b]	5 to 7	.....
Barmen-Elberfeld	" [e]	"	£2	.....	.....
Hagen	" [e]	"	£2 6s.	6	.....
Gladbach	"	....	£3 2s.	4.3	.....
Neuenburg	" [e]	....	£2 16s.	11.3	.....
Nuremburg-Fürth	"	....	.....	6.2	£ 650
Dresden	Watt.	504	£3 15s.	.....	.....
Mulhausen	"	19	.....	10	.....
Stockholm	"	All cars.	£6 17s.	5.75	£ 1,925
Bordeaux	Amp.-hour.	"	£4 5s.[f]	10	£ 1,600
Marseilles	"	10	.....	.....	.....
"	Clock.	15	.....	.....	.....
East Paris	Amp.-hour.	287	£5 13s.[g]	7.27	£ 2,419

[a] Installed after comparative tests of clock and wattmeters. The cost of repairs is practically nil; the administration expenses are about 0.0026d. per car mile. [b] The administration expenses are 0.004d. per car mile. [c] On 10 cars. [d] Repairs costs are 0.0004d., and administrative expenses 0.01d., per car mile. [e] Replacing wattmeters which cost £7 10s. each. [f] The repair costs per annum are 12s. 6d. per car, and the administration expenses 0.009d. per car mile. [g] The maintenance cost is 0.005d., and the administrative expenses 0.009d., per car mile.

tributing among the most skillful pecuniary prizes whose value is proportionate to the results obtained, while at the same time disciplinary measures are taken against those whose work leaves something to be desired. This method requires the periodical classification of the *personnel* by determining, as exactly as possible, the relation between the energy consumed by each motorman to the standard eneergy consumption for the work done. This method also predicates, as a logical conclusion, the employment of either a watt or ampere-hour meter.

"In the second way an attempt is made to get the different motormen to do their work in as uniform manner as possible. They are no longer classed according to the energy they consume, but by the way they differ from a standard line of operation. In this case a clock meter may be employed, the results which it gives being sufficient, always allowing that its work is supplemented by personal supervision, which must increase as the *personnel* becomes less conscientious.

"If a system is operated by a *personnel* who are favourable to the idea of rewards, while the system itself is of such a nature that supervision of the motormen is difficult, while the amount of traffic leads to frequent stoppages, the gradient profile is irregular, the cars are heavy, the motors closely designed, the price of energy is high, etc., all conditions tending to increase the influence of the motormen on the operating expenses, the solution given first above is to be recommended. If the conditions under which the system operates are quite the reverse of these, the second solution is preferable."

M. Bouton's conclusions as to the inefficiency of clock meters are not supported by M. Battes, who also submitted a report on the replies to the *questionnaire* at the same meeting of the Union Internationale. M. Battes gives data of the savings effected by the use of car meters, which are summarized in Table 2. "From these results," he says, "it appears that important systems cannot do without some sort of control over the energy consumed, while this control may be practically realized by means of some relatively simple apparatus. The different systems of control, whether by wattmeters, ampere-hour meters or clock meters, have given quite favorable results. The majority of the companies who have answered the questions use clock meters, and these instruments have indubitably furnished results quite as good as either wattmeters or ampere-hour meters. Besides, taking into account the importance of the financial results obtainable, the first cost and costs of upkeep, which are much higher for the last two types than for clock meters, can certainly be neglected, and each system may, therefore, be allowed the choice of determining what sort of instrument it should use."

THE ENGINEERING INDEX

"THE KEYSTONE IN·THE·ARCH·OF·APPLIED·SCIENCE"

The following pages form a *descriptive* index to the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world—in the English, French, German, Dutch, Italian, and Spanish languages.

The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the character and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

☞ The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us.—See the "Explanatory Note" at the end of the Index, where also the full titles of the principal journals indexed are given.

NOTE—The busy engineer will also observe that the Index is conveniently classified into the larger divisions of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

DIVISIONS OF THE ENGINEERING INDEX.

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CIVIL ENGINEERING.

BRIDGES.

Causeways.

The Galveston Causeway. Illustrated detailed description of a two-mile railway and highway structure between Galveston Island and the main land, now under construction. 3000 w. Eng Rec—Oct. 15, 1910. No. 17862.

Culverts.

Laying and Repairing Cast Iron Pipe Culverts in Soft Ground. Information from replies to letters of inquiry sent out by a committee of the Am. Ry. Bridge & Building Assn. 2700 w. Eng Rec—Oct. 22, 1910. No. 18116.

Drawbridges.

Erection and Elevation of a Double-Track Drawbridge Under Traffic. W. L. Six. Illustrated description of work in connection with track elevation work at Milwaukee, in which novel methods were employed in erecting a drawbridge across the Kinnickinnic River. 3000 w. Eng News—Oct. 6, 1910. No. 17718.

We supply copies of these articles. See page 487.

See also same title, under ELECTRICAL ENGINEERING, POWER APPLICATIONS.

Foundations.

Foundations of the Rüstringer Bridge at Wilhelmshaven (Fundierung der Rustringer Brücke bei Wilhelmshaven). Herr Röhlke. Describes the construction of foundations for a swing bridge over the Ems-Jade canal. Ills. 4500 w. Beton u Eisen—Sept. 2, 1910. No. 18071 F.

Masonry.

Stone Highway Bridges. J. H. Everest. Gives the stress diagram, with its application to design of masonry bridges. Supplement. 3500 w. Surveyor—Oct. 7, 1910. No. 17901 A.

Piers.

The St. Louis Municipal Bridge Substructure. Illustrated description of methods used in constructing the piers of this double-deck, double-track railway and highway structure. 2200 w. Eng Rec—Oct. 15, 1910. No. 17863.

Quebec.

The North Caisson of the Quebec Bridge. Illustrates and describes details of design and construction. 1200 w. Eng Rec—Oct. 1, 1910. No. 17592.

Building and Sinking the Quebec Bridge North Caisson. Illustrated detailed description of this feature of the work, and of the temporary house protecting the caisson during construction. 1800 w. Eng Rec—Oct. 15, 1910. No. 17869.

Reconstruction.

The Reconstruction of the Old West Viaduct at the Amsterdam Central Station (De Dichting van de oude Westelijke Viaduct op het Centraalstation te Amsterdam). J. W. Nierstrasz. Illustrated description of the work and of the new structure. 5800 w. De Ingenieur—Sept. 17, 1910. No. 18211 D.

Reinforced Concrete.

A Short Description of the Existing Bridges at Waterford and Portumna, and of the Proposed New Structures to Replace them. Ills. Discussion. 8000 w. Trans Inst of Civ Engrs of Ireland—Vol. XXXVI. 1910. No. 18223 N.

The Erection of a Reinforced-Concrete Bridge in Two Sections (Herstellung einer Eisenbetonbrücke in zwei Bauabschnitten). Hermann Roch. Describes the design and construction of a highway bridge of the girder type. Ills. 3000 w. Beton u Eisen—Sept. 24, 1910. No. 18075 F.

Steel.

An Eight-Track Overhead City Bridge. Elevation, erection and brief description of an 8-track bridge with ballasted floor across Broadway in Buffalo, N. Y. 900 w. Eng Rec—Oct. 1, 1910. No. 17590.

Viaducts.

The Providence Station Viaduct. Illustrated detailed description of structural features of interest. 1700 w. Eng Rec—Oct. 22, 1910. No. 18123.

The Penhorn Creek Viaduct of the Erie Railroad. Illustrated detailed description of this new viaduct near Jersey City, N. J. 5000 w. Eng News—Oct. 13, 1910. No. 17838.

Reinforcement of the Pecos River Viaduct. Illustrates and describes reinforcement to meet requirements of the present practice of heavy engine loading of this viaduct on the So. Pacific in Texas. 1500 w. Ry Age Gaz—Oct. 14, 1910. No. 17854.

The Strengthening of the Pecos River Viaduct. Illustrates and describes work, made necessary by the heavy engine loading of present practice, on this viaduct in Texas. 1200 w. Eng Rec—Oct. 29, 1910. No. 18245.

The Sitter Viaduct on the Bodensee-Toggenburg Railway (Der Sitterviadukt der Bodensee-Toggenburgbahn). A. Acatos. Detailed description of the construction of a high masonry-arch structure with one long steel-truss span. Ills. Serial. 1st part. 2000 w. Schweiz Bau—Sept. 10, 1910. No. 18056 B.

See also Reconstruction, under BRIDGES.

CONSTRUCTION.

Beams.

See Columns, under CONSTRUCTION.

Boring.

Methods of Conducting Test Borings and of Sinking Shafts for the Hudson River Crossing of the Catskill Aqueduct. A description of the work, with diagrams. 5000 w. Engng-Con—Oct. 26, 1910. No. 18189.

Coal Pockets.

Two Reinforced Concrete Coal Pockets. Myron S. Falk. Describes two pockets built during the past year. One in Brooklyn, the other in New York City. Ills. 1500 w. Pro Am Soc of Civ Engrs—Oct., 1910. No. 18216 F.

Columns.

Bending Moments in Concrete Wall Columns and Fixed Beams. Gives mathematical investigations and conclusions in connection with the sheet-metal shop of E. Van Noorden, in Boston. 2500 w. Eng Rec—Oct. 15, 1910. No. 17865.

Tests of Centrally and Eccentrally Loaded Brick and Concrete Columns (Versuche mit zentrisch und mit exzentrisch belasteten Pfeilern aus Backsteinmauerwerk und aus Beton). C. Bach. Describes the tests and gives detailed results. Ills. 6000 w. Zeitschr d Ver Deutscher Ing—Sept 24, 1910. No. 18203 D.

Concrete Mixers.

New Devices for Preparing and Mixing Concrete (Neuere Maschinen zur Betonbereitung und Verarbeitung). Describes exhibits at the Second Exhibition of the

clay, cement, and lime industries at Berlin. Ills. Serial. 1st part. 1000 w. Deutsche Bau—Sept. 24, 1910. No. 18054 B.

Mortar and Concrete Mixers at the Second Exposition at Berlin (Le Mescolatrici da Malta e Calcestruzzo alla II Esposizione di Berlino). Describes the exhibits. Ills. 2500 w. Il Cemento—Sept. 30, 1910. No. 18029 D.

Contractors' Plants.

The Construction Plant for the Holter Dam. Illustrated description of the arrangement of the contractor's camp and of the general methods of construction at a hydroelectric development in Montana. 3500 w. Eng Rec—Oct. 29, 1910. No. 18243.

See also Reservoirs, under WATER SUPPLY.

Cost-Keeping.

Organization and Cost-Keeping on the Los Angeles Aqueduct. Explains the scheme for keeping records of the progress and cost of this great engineering work. 2500 w. Eng Rec—Oct. 15, 1910. No. 17867.

Excavation.

Earth Excavation (Die Bodengewinnung bei grossen Erdarbeiten). H. Contag. Discusses the cost of excavation by hand labor and machine, with a review of German practice. Ills. Serial. 1st part. 7200 w. Zeitschr d Ver Deutscher Ing—Sept. 3, 1910. No. 18096 D.

Fireproof.

Fireproof Building Construction. E. T. Cairns. A discussion of fire waste and the factors that cause it, construction, design, materials, etc. 6000 w. Stevens Ind—Oct., 1910. No. 17728 D.

Modern Practice in Factory Construction from a Fire Protection Standpoint. William D. Grier. Discusses the layout and construction of manufacturing plants and their care and management to prevent fire or explosion. 4500 w. Stevens Ind—Oct., 1910. No. 17730 D.

See also Mine Buildings, under MINING AND METALLURGY, MINING.

Floors.

The Türk Hollow Reinforced-Concrete Floor (Eisenbeton-Hohldecke von Türk, Mannheim). A. Marx. A description of this type of hollow concrete floor with some data of cost. Ills. 3000 w. Beton u Eisen—Sept. 2, 1910. No. 18073 F.

Foundations.

Erection of the Substructure of the Pennsylvania Terminal Post Office. Illustrated description of unusual work at the Penn. terminal, New York City, in erecting a post-office building over the depressed tracks in the yard. 2200 w. Eng Rec—Oct. 1, 1910. No. 17595.

Unusual Foundations for a Twelve-Story Building. Foundation work in West 26th St., New York City, is illustrated and described—30 steel columns carried on clusters of 3 to 6 steel and concrete piles driven to bearing on solid rock at depths of 30 to 40 ft. below curb. 2500 w. Eng Rec—Oct. 8, 1910. No. 17769.

Hoppers.

The Deformations of a Four-Sided Hopper. Clyde T. Morris. An experimental study of the stresses in such structures and the most efficient position of the stiffeners. Ills. 1500 w. Eng News—Oct. 6, 1910. No. 17721.

Hydraulic Filling.

A Hydraulic Fill in the Turlock Irrigation District Canal. A. Kempkey, Jr. Illustrated detailed description of the replacing of the "Peaslee Gulch" flume with a permanent structure. 1500 w. Eng Rec—Oct. 29, 1910. No. 18246.

Pipe Tunnels.

Pipe Subways in European Cities. Information from a recent report by Nelson P. Lewis. 4000 w. Eng News—Oct. 27, 1910. No. 18198.

Reclamation.

The Drainage of Northeastern Arkansas. Arthur E. Morgan. Describes the area considered, including about 1,000,000 acres, and the proposed plan of improvement. 3500 w. Mfrs' Rec—Oct. 6, 1910. Serial. 1st part. No. 17700.

See also Irrigation, under WATER SUPPLY.

Reinforced Concrete.

Steel Wire Concrete Reinforcement. Illustrates and describes the use of woven fabric in various forms of construction. 1400 w. Ir Trd Rev—Oct. 27, 1910. No. 18227.

Rapid Formulae for the Calculation of Reinforced-Concrete Beams (Formules rapides pour le Calcul des Poutres en Béton armé). M. Rougié. Derives simple approximate formulae. Ills. 3000 w. Rev Indus—Sept. 17, 1910. No. 18015 D.

See also Columns, and Stadium, under CONSTRUCTION.

Retaining Walls.

The Cracking and Partial Failure of Abutments and Retaining Walls. Charles K. Mohler. Charges bad design and poor economy in past and present practice of wall construction, giving examples. Ills. 3000 w. Eng News—Oct. 13, 1910. No. 17839.

Wing Walls in Reinforced Concrete (Flügelmauern aus Eisenbeton). E. Elwitz. Works out a numerical example of the design of a wall of this type. Ills. 3500 w. Beton u Eisen—Sept. 24, 1910. No. 18074 F.

The Determination of Retaining-Wall Sections (Ueber die Querschnittsbestimmung von Staumauern). Mathematical discussion of the stresses in retaining walls of various sections. Ills. 3000 w. Oest Wochenschr f d Oeffent Baudienst—Sept. 3, 1910. No. 18068 D.

We supply copies of these articles. See page 487.

Sheet-Metal.

Sheet-Metal Construction of Pier Sheds. Illustrated explanation of methods employed in handling corrugated iron, skylights, and ornamental iron. 3500 w. Met-Work—Oct. 29, 1909. No. 18238.

Stables.

Structural Improvements in a Large Stable. Improvements in Stable A, of the New York Department of Street Cleaning, are illustrated and described. 2000 w. Eng Rec—Oct. 8, 1910. No. 17773.

Stadium.

The Tacoma High School Stadium. Leslie D. Howell. States the conditions affecting the plans, and illustrates and describes the structure in reinforced-concrete which has a seating capacity of 30,000. 2500 w. Eng Rec—Oct. 29, 1910. No. 18247.

Tunnels.

The Otira Tunnel, New Zealand. Brief illustrated description of a tunnel under construction through the Southern Alps. 500 w. Engr, Lond—Oct. 7, 1910. No. 17914 A.

Tunneling on Los Angeles Aqueduct. R. L. Herrick. Map and illustrated description of conditions found and methods used. 6500 w. Mines & Min—Oct., 1910. No. 17613 C.

Excavation of Walkill Pressure Tunnel, Catskill Aqueduct (New York City Water Supply). C. Raymond Hulsart. Map and illustrated description of the pressure tunnel type of construction, and details of the work. 4500 w. Eng News—Oct. 20, 1910. No. 17955.

Underpinning.

Deep Underpinning Through Sand. Illustrated explanation of main wall needles supported on cribbing as used in work at 26th St. and 5th Ave., New York City. 1500 w. Eng Rec—Oct. 22, 1910. No. 18117.

MATERIALS OF CONSTRUCTION.

Bituminous Materials.

The Properties of Asphalt and Bituminous Materials (Contributo sperimentale alla Cognoscenza dei Bitumi sulle Proprieta fisico-tecniche degli Asfalti e dei Bitumi). G. Maderna. Discusses methods of testing, etc. Ills. Serial. 1st part. 4500 w. Il Cemento—Sept. 30, 1910. No. 18028 D.

Concrete.

The Behavior of Hydraulic Compounds in Sea Water. H. Burchartz. Gives results of strength units and observations of concrete blocks. 3000 w. Engr, Lond—Oct. 14, 1910. No. 18167 A.

The Influence of the Electric Current on Concrete (Versuche über den Einfluss des elektrischen Stromes auf Beton). W. Gehler. Reviews briefly Knudson's results and reports a more recent series of tests made in Germany. Ills. Serial. 1st part. 4000 w. Beton u Eisen—Sept. 2, 1910. No. 18072 F.

Paints.

The Preparation of Magnetic Oxides of Iron from Aqueous Solutions. Siegfried Hilpert. Read before the Iron & Steel Inst. Gives experiments and results in proof of disagreement of conclusions reached in a paper by Mr. Carulla, as to the chemical and mechanical reactions involved. 1200 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17814 A.

Reinforced Concrete.

Bond-Friction-Resistance in Reinforced Concrete. William Fry Scott. An investigation of the reinforced-concrete beam, giving the various steps leading to the final results. Ills. 7500 w. Pro Am Soc of Civ Engrs—Oct., 1910. No. 18215 F.

MEASUREMENT.

Surveying Instruments.

The Mathematical Instrument Office of the Survey of India. Illustrated description of the instruments of precision used, and an outline of the work carried on by one of the largest concerns of its kind in the world. 1800 w. Engr, Lond—Sept. 30, 1910. Serial. 1st part. No. 17832 A.

MUNICIPAL.

City Planning.

The Art of Laying Out Cities. F. Bottge. An illustrated account of recent progress on the Continent. 2000 w. Cassier's Mag—Oct., 1910. No. 17695 B.

Tramways in Relation to Town Planning. A. Baker. Paper and discussion before the Munic. Tram. Assn. Considers the damage done in developing suburban areas, the advantage of tramway traffic and the administration of the town planning act. Ills. 12500 w. Tram & Ry Wld—Oct. 6, 1910. No. 18151 B.

Industrial Wastes.

Present Status of the Disposal of Sulphite Liquor in Germany. Dr. A. Pritzkow. Abstract translation. A review of the work of the Royal Testing Institute, giving an outline of the present status of this problem. 3000 w. Eng Rec—Oct. 22, 1910. No. 18121.

Pavements.

Wooden Block Pavement Tests in Minneapolis, Minn. D. M. Avery. An illustrated report of the results obtained with five kinds of wood. 1500 w. Munic Engng—Oct., 1910. No. 17983 C.

The Concrete and Macadam Streets of Richmond, Ind. Information concerning these pavements and their cost. 1500 w. Munic Engng—Oct., 1910. No. 17984 C.

Street Paving in New Orleans. Martin Behrman. Read before the League of Am. Municipalities. Information concerning the kinds of pavement, cost, etc. 1800 w. Munic Engng—Oct., 1910. No. 17982 C.

The Victoria Embankment Pavement. Information from the report issued by the

We supply copies of these articles. See page 487.

Engng. Dept. of the London County Council in Jan., 1910, in regard to the extensive paving experiments on this thoroughfare carrying a very heavy traffic. 1400 w. Eng Rec—Oct. 22, 1910. No. 18115.

Refuse Disposal.

The Practical Questions Concerned in the Collection and Disposal of Municipal Waste. William F. Morse. Considers the engineering problems involved in the past and present methods and apparatus in use in America for the treatment and disposal of municipal waste. General discussion. Ills. 12500 w. Jour Assn of Engng Socs—Sept., 1910. No. 17999 C.

Roads.

The Economics of Modern Highway Engineering. Arthur H. Blanchard. Read before the Am. Soc. for Munic. Imp. Considers the construction of roads and streets subject to modern traffic. 2000 w. Eng Rec—Oct. 22, 1910. No. 18119.

Modern Surface Treatments of Roads. Charles W. Ross. Read before the Nat. Good Roads Con. A critical discussion of modern methods, with report of results from various treatments. 2500 w. Eng Rec—Oct. 15, 1910. No. 17864.

Protective Coatings for Roads in Massachusetts. Austin B. Fletcher. Read at the Brussels Int. Cong. Considers the change in traffic conditions and the effect on roads, reporting resurfacing and other road work during 1908 and 1909. 2800 w. Eng Rec—Oct. 1, 1910. No. 17596.

Dustless Roads of California. Austin B. Fletcher. Read before the Nat. Good Roads Convention. Conditions in So. California are discussed, and the efforts to lessen the dust nuisance. 3500 w. Eng Rec—Oct. 8, 1910. No. 17776.

Dustless Roads in Europe. Arthur H. Blanchard. Read before the Nat. Good Roads Con. Discusses unique features of European practice which deserves the careful consideration of American engineers. 5000 w. Eng Rec—Oct. 1, 1910. No. 17598.

Road Drainage. From the last report of W. A. McLean, Ontario, Canada. Especially considers conditions in Canada, showing drainage to be the essential principle in road construction. 2200 w. Engng-Con—Oct. 26, 1910. No. 18190.

The Development of Panama by Public Roads. Edward Perry. An illustrated account of the government policy in road construction and improvement. 2000 w. Engineering Magazine—Nov., 1910. No. 18256 B.

Continuous and Systematic Road Maintenance. S. Percy Hooker. Read before the Nat. Good Roads Assn. Directions for the care of improved roads and the cost. 2500 w. Eng Rec—Oct. 8, 1910. No. 17768.

Cost of Rural Road Building in Peel County, Ontario. C. R. Wheelock. Information from a recent report of work done on different classes of roads, with costs. 2000 w. Can Engr—Oct. 6, 1910. No. 17783.

Septic Tanks.

The Present Utility of the Septic Tank. H. N. Ogden. Read before the Am. Soc. of Munic. Imp. Explains what the septic tank accomplishes and its limitations. 1700 w. Engng-Con—Oct. 19, 1910. No. 17949.

Sewage Disposal.

Economy in Sewage Disposal. C. Chambers Smith. Read before the Roy. San. Inst. Deals with conditions in England, suggesting ways by which economy may be advanced. Discussion. 3000 w. Surveyor—Sept. 23, 1910. No. 17666 A.

First-Hand Impressions of German Sewage Disposal. H. N. Ogden. General remarks, with information concerning methods and their application to conditions in the United States. Also editorial on "The Need for a More Rational View of Sewage Disposal," and a letter from Palmer C. Ricketts on stream pollution. 8600 w. Eng News—Oct. 13, 1910. No. 17840.

Diffusion and Digestion of Sewage in New York Harbor. Discussion from the report of the Metropolitan Sewerage Commission, based on extensive studies. 18000 w. Engng Con—Oct. 26, 1910. No. 18192.

Sewage Disposal Works, Alliance, Ohio. E. G. Bradbury. Explains conditions and describes a new plant providing for sedimentation and double filtration, to prevent the pollution of a river used for water supply. 2500 w. Eng Rec—Oct. 15, 1910. No. 17866.

Sewage Disposal System of Toronto. C. H. Rust. Read before the Am. Soc. of Munic. Imp. Illustrated description of the treatment previous to the discharge into Lake Ontario. 2500 w. Munic Jour & Engr—Oct. 26, 1910. No. 18183.

A Novel House and Street Sewerage System for Portions of Manila, P. I. George H. Guerdrum. Describes a system for the drainage of the sanitary barrios now being built. Ills. 900 w. Eng News—Oct. 6, 1910. No. 17717.

Sewage Pumping.

See Pumping Plants, under MECHANICAL ENGINEERING, HYDRAULIC MACHINERY.

Sewers.

The Maximum Flow of Storm Water in Sewers. P. H. M'Carthy. Discusses methods of determining the necessary allowance for storm water in sewers. Tables and discussion. 6 plates. 8400 w. Trans Inst of Civ Engrs of Ireland—Vol. XXXVI., 1910. No. 18222 N.

Reinforced Concrete Sewers in Soft Ground, Seattle. Illustrates and describes the sewers being constructed through the reclaimed area, explaining the conditions. 1500 w. Eng Rec—Oct. 22, 1910. No. 18120.

We supply copies of these articles. See page 487.

Condition of Manhattan Sewers. An illustrated summary of conditions found during a recent inspection. 1800 w. Munic Jour & Engr—Oct. 5, 1910. No. 17702.

WATER SUPPLY.

Aqueducts.

See Cost Keeping, under CONSTRUCTION; and Siphons, under WATER SUPPLY.

Catskill.

See Boring, under CONSTRUCTION; and Reservoirs and Siphons, under WATER SUPPLY.

Dams.

The Design of Reservoir Dams, with Some Accounts of Failures. F. C. Uren. Discusses the considerations influencing the design, the causes affecting stability and related subjects. Describes failures in earth and masonry dams. Discussion. 5 plates. 23500 w. Trans Inst of Civ Engrs of Ireland—Vol XXXVI., 1910. No. 18218 N.

The Design and Construction of the St. Andrews Movable Dam and Lock on the Red River at Lockport, Manitoba. Edwin A. Forward. Illustrated detailed description. 4500 w. Eng News—Oct. 6, 1910. No. 17716.

An Arched Dam at Las Vegas, New Mexico. Explains details of the design and reasons for adopting particular features. 1500 w. Eng Rec—Oct. 8, 1910. No. 17770.

Arched Masonry Dam at Las Vegas, N. M. Charles W. Sherman. Gives reasons for the construction of this dam and the adoption of the type and of details, describing local conditions affecting the problem. Ills. 3000 w. Eng News—Oct. 27, 1910. No. 18197.

Progress of the Great Barren Jack Dam in Australia. Gives details of a structure of Cyclopean convents, which will be one of the largest of its kind in the world. 2200 w. Engr, Lond—Sept. 23, 1910. No. 17681 A.

Storage Curves (Staukurve). Leo Bloudek. An addition to the author's paper on this subject in this journal for Jan. 22, 1910. Ills. 2000 w. Oest Wochenschr f d Oeffent Baudienst—Sept. 17, 1910. No. 18070 D.

See also Locks, under WATERWAYS AND HARBORS.

Derwent Valley.

Derwent Valley Water Scheme. Map, showing the scheme for supplying the towns of Leicester, Derby, Sheffield and Nottingham, in England, with illustrated description of the work. Plate. 2000 w. Engr, Lond—Oct. 14, 1910. No. 18168 A.

Filtration.

Filtration Works and Reservoirs for Portsmouth Water Supply. Illustrated description of new works and information concerning them. 3500 w. Engr, Lond—Oct. 7, 1910. No. 17912 A.

Portsmouth Water Works. Illustrates and describes the new filter-beds and covered service reservoirs recently put into commission. 2500 w. Plates. Engng—Oct. 7, 1910. No. 17909 A.

The Mechanical Filter Plant at Wilkinsburg, Pa. Illustrated description of plant for the purification of the water supply. 1500 w. Eng Rec—Oct. 1, 1910. No. 17597.

The Filter Plant at Helsingforz, Finland. E. A. Gieseler. Brief description of conditions and plant, with report of operating results. 1000 w. Eng Rec—Oct. 1, 1910. No. 17593.

Fire Protection.

Automatic Sprinkler Protection. E. P. Boone. Explains the sprinkler system, discussing its proper installation. Ills. 4500 w. Stevens Ind—Oct., 1910. No. 17729 D.

The New Fire-Protection Organization in Milan and the Electric Alarm System (La nuova Organizzazione del Servizio di Estinzione incendi a Milano e l'Impianto di Avvisatori elettrici d'Incendio). Nino Sacerdoti. Ills. Serial. 1st part. 3000 w. Monit Tech—Sept. 10, 1910. No. 18026 D.

Irrigation.

Irrigation Accounting, Its Essentials and Advantages. N. E. Webster, Jr. Condensed paper for the Inst. Irrigation Cong. A study of the phases which are common to all irrigation projects and should be shown in the accounts. 1600 w. Eng News—Oct. 6, 1910. No. 17720.

The Agricultural Side of Irrigation. S. Fortier. On the importance of the agricultural side of the subject, the difficulties, the proper use of water, assistance needed, etc. 2200 w. Eng News—Oct. 27, 1910. No. 18196.

Drainage of Irrigated Lands with Special Reference to Experiments in Utah. Charles F. Brown. Condensation of Farmers' Bulletin, No. 371, U. S. Dept. of Agriculture. Information concerning methods of reclaiming irrigated lands affected by excess of water or alkali, based on work done in Utah. Ills. 6000 w. Eng News—Oct. 13, 1910. No. 17841.

The Las Vegas Irrigation Project, New Mexico. H. H. Barnett. Illustrated description of a collapsible dam and canal system. 2000 w. Eng Rec—Oct. 8, 1910. No. 17766.

Pipe Flow.

See Water, under MECHANICAL ENGINEERING, MEASUREMENT.

Pipe Laying.

Labor Cost of Laying 16 Miles of 20-Inch Cast Iron Water Main at Cheyenne, Wyo. M. V. Moulton. Description of the work. 1600 w. Engng-Con—Oct. 26, 1910. No. 18191.

Pipe Strength.

The Collapsing Pressure of Circular Tubes. W. E. Lilly. Develops a rational

formula for the collapsing strength of circular tubes under external fluid pressure, showing where the theory, as usually interpreted, is defective. Discussion. Plate. 6500 w. Trans Inst of Civ Engrs of Ireland—Vol. XXXVI., 1910. No. 18220 N.

Pipe Tunnels.

See same titles, under CONSTRUCTION.

Pollution.

Pure Water and the Pollution of Waterways. Dr. Hodgetts. Extracts from an address at Ottawa, before the Dom. Pub. Health Conf. A general discussion of pure water supply, pollution of waterways and disposal of sewage. 3000 w. Can Engr—Oct. 27, 1910. No. 18239.

Portland, Ore.

Enlargement of the Water Works of Portland, Ore. Explains conditions and the plans for improving the service. 1500 w. Eng Rec—Oct. 22, 1910. No. 18114.

Purification.

Water Purification Plant at Richmond, Virginia. Describes a plant for the purification of James River water, by selection of water, long time storage, and coagulation with aluminum sulphate and sedimentation. 1800 w. Eng Rec—Oct. 22, 1910. No. 18118.

Reservoirs.

Cobb's Hill Reservoir, Rochester, N. Y. John F. Skinner. Illustrated description of an unusually large concrete-lined reservoir, with double concrete and waterproofing bottom. 2200 w. Munic Jour & Engr—Oct. 19, 1910. No. 17965.

Methods of Construction and Contractor's Plant on the Ashokan Reservoir, New York Water Supply. Map and illustrated description of construction work in this great storage basin for the Catskill supply. 5000 w. Engng Con—Oct. 19, 1910. No. 17948.

See also Filtration, under WATER SUPPLY.

Siphons.

The Hudson River Siphon Crossing of the Catskill Aqueduct. Samuel D. Dodge and William B. Hoke. Read before the Munic. Engrs. of the City of N. Y. (Slightly altered). Describes the vertical and inclined borings and the test shafts to determine the location and depth for the proposed pressure tunnel which will carry the Catskill supply beneath the Hudson. 6000 w. Eng Rec—Oct. 8, 1910. Serial. 1st part. No. 17775.

Tacoma.

The Green River Gravity Water Supply of Tacoma. Stuart Sims. Plan and description of a project for furnishing an additional supply from an upland river. 2500 w. Eng Rec—Oct. 22, 1910. No. 18122.

Water Towers.

Ornamental Standpipe at Syracuse, N. Y. M. B. Palmer. Illustrated detailed description of a masonry shell enclosing a steel tank. 2000 w. Munic Jour & Engr—Oct. 5, 1910. No. 17701.

Concrete Tower Enclosing a Water-Works Tank at Gary, Ind. Illustrated description of a reinforced-concrete water tower, enclosing a steel tower and tank. 1200 w. Eng News—Oct. 20, 1910. No. 17953.

Methods of Constructing a Reinforced Concrete Water Tower Using Steel Forms and Movable Steel Staging. Illustrates and describes methods recently employed at Westerly, R. I. 800 w. Engng-Con—Oct. 5, 1910. No. 17704.

WATERWAYS AND HARBORS.

Austria.

Interior Navigation in Austria (Bericht über den Stand der Wasserstrassenfrage). An abstract of an official report of progress in canal building and river improvement, with an outline of the projects in hand and proposed. Ills. Serial. 1st part. 8000 w. Oest Wochenschr f d Oeffent Baudienst—Sept. 10, 1910. No. 18069 D.

See also same title, under RAILWAY ENGINEERING, MISCELLANY.

Canal Spillways.

Siphon Spillways on the Champlain Canal. Illustrations and description, taken from the *Barge Canal Bulletin*. 1000 w. Eng Rec—Oct. 8, 1910. No. 17767.

Genoa.

The Port of Genoa (Sul "Porto di Genova"). Mattia Giavotto. Discusses particularly its value as a naval base. Ills. 5000 w. Riv Marit—Sept., 1910. No. 18023 D.

Locks.

Locks and Dams of the Panama Canal. Illustrated detailed description of the work at Gatun, and the methods of construction. 4500 w. Engr, Lond—Sept. 30, 1910. Serial. 1st part. No. 17833 A.

Marine Staging.

Self-Propelled Marine Staging. Brief illustrated description of marine locomotive staging used in England for construction of marine works or excavation. 800 w. Eng Rec—Oct. 8, 1910. No. 17772.

Panama Canal.

A Trip Across the Isthmus: Life and Conditions on the Canal Zone. Martin Nixon-Miller. Reviews the history of this scheme, and describes conditions, giving a brief outline of the work. 6000 w. Pro Engrs' Club of Phila. No. 1092—Oct., 1910. No. 18251 D.

See also Locks, under WATERWAYS AND HARBORS.

Piers.

Loughshinny Pier, County Dublin. W. Collen. Gives the history of this small pier for the accommodation of fishermen, explaining the difficulties and describing the work. 2 plates. Discussion. 10000 w. Trans Inst of Civ Engs of Ireland—Vol. XXXVI., 1910. No. 18221 N.

River Regulation.

Stream Regimen and Dam Construction in the Eastern Alps (Flussregime und Talsperrenbau in den Ostalpen). Discussion of M. Singer's paper published in this journal for Dec. 10 and 17, 1909. Ills. 9000 w. Zeitschr d Oest Ing u Arch Ver —Sept. 30, 1910. No. 18067 D.

Water Powers.

Water Powers. Herbert Knox Smith. Address before the National Conservation Congress. Explains the present situation of the hydro-electric industry and the importance and aim of federal jurisdiction. 1300 w. Eng News—Oct. 20, 1910. No. 17954.

ELECTRICAL ENGINEERING.

COMMUNICATION.

Fire Alarms.

The Reconstruction of the New York Fire Alarm Telegraph System. Herbert T. Wade. Describes features of the proposed system. 2000 w. Sci Am—Oct. 8, 1910. No. 17724.

See also Fire Protection, under CIVIL ENGINEERING, WATER SUPPLY.

Radiotelegraphy.

Experiments in Directive Wireless Telegraphy and Other Means for Securing Selectivity. J. O. Mauborgne. Considers results of experiments made with a view of obtaining greater certainty of transmission. 5000 w. Jour U S Art—Sept.-Oct., 1910. No. 17939 D.

Properties of the Most Important Detectors Used in Wireless Telegraphy. K. Bangert. Abbreviated translation from *Phys. Zeit.* Discusses the behavoir of the electrolytic and galena detectors and the various effects, and describes experiments. 2500 w. Elect'n, Lond—Oct. 14, 1910. No. 18154 A.

The Efficiency of Short-Spark Methods of Generating Electrical Oscillations. W. H. Eccles and A. J. Makower. Examines methods used to estimate the efficiency. 1400 w. Elect'n, Lond—Sept. 30, 1910. No. 17822 A.

Radiotelephony.

Experimental Apparatus for Wireless Telephony. Illustrates and describes apparatus constructed by E. F. Huth, of Berlin, aiming to prove the possibilities of wireless telephony for practical application. 1500 w. Elect'n, Lond—Oct. 7, 1910. No. 17896 A.

Telegraphy.

Discussion on "American Telegraph Engineering—Notes on History and Practice," Jefferson, N. H., June 29, 1910. Discussion on paper by William Maver, Jr., and Donald McNicol. 2500 w. Pro Am Inst of Elec Engrs—Oct., 1910. No. 17989 F.

Telephone Rates.

The Regulation of Telephone Rates and Service in Massachusetts. An account of the revision of telephone rates in Boston and vicinity to place them on an equitable basis. With editorial discussion. 8000 w. Eng News—Oct. 20, 1910. No. 17956.

Telephony.

Telephone Service in America. John J. Carty. Address at Paris, France, giving a review of the progress of the art and an analysis of the methods of operation of the manual and antomatic systems. Also editorial. 8800 w. Elec Rev, N Y—Oct. 15, 1910. No. 17874.

DISTRIBUTION.

Condensers.

Some Investigations on a Celluloid Condenser. G. Vallauri. Abstract of paper in the *Pro. Assn. Elettro. Italiana.* Describes the condenser and experiments made with it. 1200 w. Elect'n, Lond—Oct. 14, 1910. No. 18156 A.

Switches.

New Electric Remote-Control Apparatus (Neuere elektrische Fernsteuerungen). W. Wolf. Describes in detail a number of devices and installations. Ills. Serial. 1st part. 1500 w. Elektrotech Rundschau—Sept. 15, 1910. No. 18077 D.

DYNAMOS AND MOTORS.

A. C. Dynamos.

Discussion on "Parallel Operation of Three-Phase Generators with Their Neutrals Interconnected" San Francisco, Cal., May 5, 1910. Discussion of George I. Rhodes' paper. 5000 w. Pro Am Inst of Elec Engrs—Oct., 1910. No. 17988 F.

A. C. Motors.

The Future of the Single-Phase Series Motor (Bemerkungen über die zukünftige Entwicklung der Einphasen-Reihenschlussmotoren). Maurice Milch. Discusses possible improvements and the probable future of this type of motor. Ills. 2500 w. Elek Kraft u Bahnen—Sept. 14, 1910. No. 18082 D.

Armatures.

Dynamo Armature Cores. Cecil P. Poole. Illustrated article showing how armatures are wound and explaining the relation between torque and the elements producing it. 1500 w. Power—Oct. 4, 1910. No. 17652.

Foundations.

Construction of Foundations for Electrical Machinery. Bruce H. Page. Illustrated article giving directions for the work. 1700 w. Elec Wld—Oct. 6, 1910. No. 17713.

We supply copies of these articles. See page 487.

Induction Motors.

Multi-Speed Squirrel-Cage Induction Motor. R. E. Hellmund. A comparison of the characteristics of the multi-speed induction motor with those of the direct-current series motor. 1500 w. Elec Wld—Oct. 13, 1910. No. 17859.

Calculation of the Magnetizing Current in Induction Motors (Beitrag zur Berechnung des Magnetisierungsstromes in Induktionsmotoren). Theodor Hoock and R. E. Hellmund. A discussion and criticism of the different methods. Ills. 4000 w. Elektrotech u Maschinenbau—Sept. 4, 1910. No. 18089 D.

Leakage Reactance.

Leakage Reactance. J. Rezelman. Deduces a method for estimating the mutual induction between the overhang coils of the different phases of a stator winding. 2000 w. Elect'n, Lond—Oct. 7, 1910. No. 17897 A.

Railway Motors.

Communication and the Interpole Railway Motor. J. L. Davis. An explanation of the advantages of the interpole design and field control, and of the theory of the interpole. Ills. 5000 w. Elec Jour—Oct., 1910. No. 17973.

See also Single Phase, under STREET AND ELECTRIC RAILWAYS.

Speed Regulation.

A New System of Speed Regulation for Single-Phase and Polyphase Induction Motors of Large and Moderate Powers (Un nouveau Système de Regulation de la Vitesse des Moteurs d'Induction à Courants alternatifs mono- et polyphasés de grande et moyenne Puissance). J. Angibaud. A description of the Scherbius system of speed regulation for induction motors. Ills. 3500 w. Soc Belge d'Elecns—Aug., 1910. No. 18002 E.

See also Rolling Mills, under MINING AND METALLURGY, IRON AND STEEL.

Windings.

The Design of Shunt Field Windings. Frank W. Merrill. Considers the relation between different variables entering into the design, and describes a method shown to be accurate and direct. 3000 w. Elec Wld—Oct. 6, 1910. No. 17712.

Winding Coefficients for Single-Phase Motors. H. Weichsel. Shows the methods for calculating the winding coefficients for different winding distributions. 2000 w. Elec Rev, N Y—Oct. 15, 1910. Serial. 1st part. No. 17873.

Theory and Construction of Polyphase Generator Windings with a Fractional Number of Slots per Pole per Phase (Theorie und Konstruktion der Teillochwicklungen für Mehrphasengeneratoren). M. Seidner. Discusses various cases in which it may be desirable to use a fractional number of slots. Ills. 5000 w. Elektrotech u Maschinenbau—Sept. 18, 1910. No. 18091 D.

ELECTRO-CHEMISTRY.

Cells.

See Standard Cells, under MEASUREMENTS.

Electric Furnaces.

A Convenient and Inexpensive Furnace for Very High Temperatures. D. F. Calhane. Brief illustrated description of a laboratory electric furnace for high temperature work. 800 w. Met & Chem Engng—Oct., 1910. No. 17762 C.

See also Refractory Materials, under MINING AND METALLURGY, MINING.

Nitrogen.

The Fixation of Atmospheric Nitrogen. Illustrated description of the Pauling process. 1500 w. Sci Am Sup—Oct. 8, 1910. No. 17726.

ELECTRO-PHYSICS.

Hysteresis.

Hysteresis Loops and Lissajous' Figures, and the Energy Wasted in a Hysteresis Loop. Prof. Silvanus P. Thompson. Abstract of a paper read before the Phys. Soc. Shows that any hysteresis loop can be analyzed into a harmonious series of closed curves corresponding to the various terms in the analysis of the current wave. Also editorial. Ills. 4000 w. Elect'n, Lond—Oct. 7, 1910. No. 17894 A.

Magnetic Properties.

The Magnetic Properties of Iron and their Utilization in Modern Electrical Construction (Ueber die magnetischen Eigenschaften von legiertem Eisen und dessen Verwendung in der modernen Elektrotechnik). Sigm. Guggenheim. Discusses the relation of the purity of the iron used and the efficiency of electrical machinery. Ills. 2000 w. Elek Kraft u Bahnen—Sept. 24, 1910. No. 18084 D.

GENERATING STATIONS.

Bus Bars

The Arrangement of Bus Bars (Die Schienenanordnungen der elektrischen Anlagen). J. Teichmüller. Illustrates and discusses a large number of arrangements. Serial. 1st part. 3800 w. Elek Kraft u Bahnen—Sept. 24, 1910. No. 18083 D.

Central Stations

The Decentralized Plant as the Power Plant of the Future. R. D. De Wolf. Abstract of a paper read before the Nat. Elec. Lgt. Assn. Explains how it will be designed and operated to supply heat, as well as power and light. 4500 w. Heat & Vent Mag—Oct., 1910. No. 18128.

Central Stations with Asynchronous Generators (Stations centrales à Génératrices asynchrones). A. R. Garnier. Discusses plants of this type and describes three installations in Germany. Ills. 2000 w. L'Elecn—Sept. 3, 1910. No. 18008 D.

Oil and Gas Fuel Station at Wichita, Kan. Illustrated detailed description of a modern plant especially noteworthy for

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compactness and economy of operation. 2500 w. Elec Wld—Oct. 20, 1910. No. 17951.

The Carville Generating Station. The development of the station at Carville-on-Tyne is outlined, and the present plant illustrated and described. Plate. 1700 w. Engr, Lond—Sept. 30, 1910. No. 17835 A.

See also Gas Power Plants, under MECHANICAL ENGINEERING, COMBUSTION MOTORS.

Economics.

The Future of the Central Station. Thomas E. Murray. Read before the Assn. of Edison Ill. Co.'s. Reviews the development, showing the applications for the electric current, and considers the future development promising. 4500 w. Cent Sta—Oct., 1910. No. 17786.

Hydro-Electric.

The Capital City Power Plant of the United Missouri River Power Co. Illustrated description of the dam and hydro-electric plant now under construction, the third of the system of this company, to furnish current for Western Montana. 1600 w. Eng News—Oct. 20, 1910. No. 17959.

The Hydro-Electric Plant of the Cobalt Power Company at Hound Chute. A. Vonaesch. Illustrated description of this development on the Montreal River, furnishing current for light, heat and power. 2500 w. Can Engr—Oct. 13, 1910. No. 17876.

A Low-Head Hydroelectric Plant. Arthur H. Ford. Illustrates and describes the engineering and economical features of the electric generating equipment of the University of Iowa. 2500 w. Elec Wld—Oct. 13, 1910. No. 17856.

The Tuilière Hydro-Electric Plant and the Distribution of Electrical Energy in the Southwest of France (L'Usine hydro-électrique de Tuilière et la Distribution de l'Energie électrique dans le Sud-Quest de la France). A. Dumas. Detailed description of the station and distribution system. Ills. 5500 w. Génie Civil—Sept. 10, 1910. No. 18018 D.

The Piedimulera Power Plant (Das Kraftwerk Piedimulera). A Menge. Detailed description of this important Italian plant serving Novara and its neighborhood. Ills. Serial. 1st part. 2000 w. Zeitschr f d Gesamte Turbinenwesen—Sept. 30, 1910. No. 18060 D.

The Sorio Station of the Milan Hydro-Electric System (La Centrale di Sorio dell' Impianto idroelettrico Milani). Brief description of the plant and machinery. Ills. 2500 w. Industria—Sept. 4, 1910. No. 18025 D.

Isolated Plants.

The Cost of Heat, Light and Power. C. M. Ripley. Abstract of address before the "Blue Room Engng Soc. of Greater N. Y." Gives operating cost and a strong argument for the isolated plant over the central station. 4500 w. Power—Oct. 25, 1910. No. 18138.

Plant of the Bigelow Carpet Company. B. S. Walters. Illustrated description of the mechanical equipment of a 1100 k.-w. a. c. plant. 1000 w. Power—Oct. 4, 1910. No. 17647.

Motor Load of Massachusetts Central Stations. Walter Stuart Kelley. A statistical study of motor loads and their peculiarities based on data from a number of stations. 3500 w. Elec Wld—Oct. 6, 1910. No. 17715.

Netherlands.

Statistics of Electricity-Supply Stations in the Netherlands (Statistiek van Centraal-Stations voor Electrische Stroomlevering in Nederland). Gives details of all central stations in the country. De Ingenieur—Sept. 10, 1910. No. 18210 D.

Rates.

A Safe Energy Rate for Small Central Stations. S. W. Borden. Explains a system of rate making recommended for small stations. 1000 w. Elec Wld—Oct. 13, 1910. No. 17860.

Practical Considerations for the Application of New Methods of Measurement to the Sale of Electrical Energy (Considerazioni practiche per l'Applicazione dei nuovi Metodi di Misura industriale per la Tarifficazione dell' Energia elettrica). Ricardo Arno. A discussion of the rate-making problem in central station economics. Ills. 4500 w. Monit Tech—Sept. 20, 1910. No. 18027 D.

Switchboards.

The Choice of Switchboard Measuring Instruments (Ueber die Wahl der Schalttafelmessinstrumente). Friedrich Blaczek. A practical discussion of the instruments required, the conditions they should fulfil, and the limits of error permissible. Ills. 3000 w. Elektrotech Rundschau—Sept. 1, 1910. No. 18076 D.

Switches.

See Insulating Materials, under MISCELLANY.

Transvaal.

Electric Power in the Transvaal. Comments on the Electric Power Act. 2500 w. Elec Rev, Lond—Oct. 7, 1910. No. 17891 A.

LIGHTING.

Arc Lamps.

Three-Phase Arc Lamp with Four Carbons. Aldo Righi. Abstract trans. from *Pro. Assn. Elettro. Italiana.* Describes the new arrangement of carbons proposed by the writer. 900 w. Elect'n, Lond—Oct. 7, 1910. No. 17893 A.

Arc Lamps for Projection. Henry Phelps Gage. Investigations made at Cornell University and in Schenectady of illuminants for projection purposes are reported, and conclusions stated. 1800 w. Elec Wld—Oct. 13, 1910. No. 17861.

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Illumination.

Recent Study of the Firefly. Herbert E. Ives. A study of the efficiency of the illumination, reporting recent investigations. Also editorial note. 2000 w. Elec Wld—Oct. 13, 1910. No. 17858.

Modern Illumination. Newton Harrison. Brief consideration of the various systems and their applications to different requirements. 2500 w. Cent Sta—Oct., 1910. No. 17785.

Practical Illumination. John Darch. Read before the Roy. San. Inst. Cong. Shows that the principles governing the practice of lighting should conform with the hygienic requirements of the eye, giving suggestions for efficient illumination. 3000 w. Elec Engr, Lond—Sept. 23, 1910. No. 17672 A.

Incandescent Lamps.

High-Power Incandescent Fittings. Notes based on practical experience in this class of work. 1500 w. Elec Rev, Lond—Oct. 7, 1910. No. 17892 A.

Some Notes from Makers of Metal Filament Lamps. Gives experiences with various makes of high-efficiency lamps. Ills. 2000 w. Elect'n, Lond—Sept. 23, 1910. No. 17677 A.

Mercury-Vapor Lamps.

Systematic Investigations of the Efficacy of the Ultra-Violet Rays from Quartz-Tube, Mercury-Vapor Lamps (Systematische Untersuchungen über die Wirksamkeit der verschiedenen ultravioletten Strahlen der Quecksilberdampf-Quartzmantel-Bogenlampen). A review of investigations at the physiological laboratory of the Sorbonne of the bactericidal effects of these rays. 3000 w. Elektrotech u Maschinenbau—Aug. 7, 1910. No. 18087 D.

See also Shop Lighting, under MECHANICAL ENGINEERING, MACHINE WORKS AND FOUNDRIES.

Photometry.

The Ulbricht Ball as a Means of Measuring Mean Spherical or Mean Hemispherical Candle Power (Die Ulbrichtsche Kugel zur Bestimmung der mittleren sphärischen bezw, der mittleren hemisphärischen Lichtstarke). Ernst Winkler-Buscher. Describes the construction and use of Ulbricht's photometric device. Ills. 4000 w. Elektrotech u Maschinenbau—Aug. 7, 1910. No. 18085 D.

Street.

A Variable Contrast Testing Device. Preston S. Millar. Illustrated description of a device for measuring the ability to see in the streets at night. 1500 w. Elec Wld—Oct. 20, 1910. No. 17952.

Outdoor Lighting in England. Norton H. Humphreys. Reports the extensive use of gas lighting, and considers the latest improvements. 2500 w. Am Gas Lgt Jour—Oct. 10, 1910. Serial. 1st part. No. 17787.

MEASUREMENT.

Dynamo Testing.

Testing of Alternators, with Results of Tests on a Three-Phase Machine. J. W. Rogers. Describes methods of making various shop tests on single and polyphase alternators. 800 w. Prac Engr—Sept. 30, 1910. Serial. 1st part. No. 17826 A.

Galvanometers.

The Comparison of Galvanometers and a New Type of Flat-Coil Galvanometer. Edwin F. Northrup. Remarks on design, describing a basis for comparing the merits of different galvanometers, and describing a new type, giving a tabulated comparisons of this type with existing instruments. Ills. 5500 w. Jour Fr Inst—Oct., 1910. No. 17935 D.

Magnetic Balance.

Magnetic Balance of MM. P. Curie and C. Cheneveau. C. Cheneveau, with an appendix by A. C. Jolley. Abstract of paper before the Phys. Soc. Shows how the coefficient of specific magnetization can be calculated from measurements with this balance, and describes the apparatus. The appendix reports the results of tests. Ills. 1300 w. Elect'n, Lond—Sept. 30, 1910. No. 17823 A.

Meters.

An Improved Electricity Meter. Describes improvements in wattmeter construction recently patented by Messrs. Siemens Bros. in conjunction with Francis Sydell. Ills. 2200 w. Prac Engr—Oct. 14, 1910. No. 18158 A.

Photographic Recording Meter. L. M. Aspinwall. Illustrated detailed description. 1200 w. Elec Jour—Oct., 1910. No. 17977.

Meter Testing.

Intervals for Testing Watt-Hour Meters. John Gilmartin. Discusses methods and data for determining the desirable test intervals. 1600 w. Elec Wld—Oct. 6, 1910. No. 17714.

Motor Testing.

Measurement of the Cross-Field Tension in Synchronous Single-Pole Machines (Ermittlung der Querfeldspannung bei synchronen Einzelpolmaschinen durch den Versuch). Karl Pichelmayer. Describes an investigation of methods of direct measurement. Ills. 2200 w. Elektrotech u Maschinenbau—Sept. 25, 1910. No 18093 D.

Standard Cells.

Limitations of the Weston Cell as a Standard of Electromotive Force. S. W. J. Smith. Abstract of paper read before the Phys. Soc. Attempts to explain in terms of the theory of solutions the author's recent experiments on the cadmium amalgams of the Weston standard cell. 3000 w. Elect'n, Lond—Oct. 14, 1910 No. 18157 A.

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POWER APPLICATIONS.

Agriculture.

Electricity on the Farm. G. Basil Barham. Considers applications made of electricity and their advantages. 1500 w. Elec Rev, Lond—Oct. 14, 1910. No. 18153 A.

Drawbridges.

The Electrical Operation of Drawbridges. S. F. Nichols. Abstract of a paper read before the Assn. of Ry. Elec. Engrs. Explains the application of the series-wound reversing electric motor to the operation of all kinds of drawbridges. 1800 w. Eng News—Oct. 13, 1910. No. 17842.

Welding.

See same Title, under MECHANICAL ENGINEERING, MACHINE WORKS AND FOUNDRIES.

TRANSMISSION.

Cables.

Potential Stresses in Dielectrics. Harold S. Osborne and Harold Pender. A discussion of high voltage insulation and the grading of cables. 7000 w. Pro Am Inst of Elec Engrs—Oct., 1910. No. 17986 F.

Tests on Bitumen Cables. W. A. Tappin. Report of tests made on the bitumen covering of cables treated in a different manner during the process of manufacture. Also methods of laying cable, localizing faults, leakages, etc. 3000 w. Elec Rev, Lond—Oct. 14, 1910. No. 18152 A.

Cable Repairs. Reports some causes of breakdowns and their repair. 1000 w. Elec Rev, Lond—Sept. 23, 1910. No. 17676 A.

Capacity.

Graphic Representations of the Linear Electrostatic Capacity Between Equal Parallel Wires. A. E. Kennelly. A graphical representation of the quantities involved, with explanation. 800 w. Elec Wld—Oct. 27, 1910. No. 18182.

Constant Potential.

A General Solution of the Problem of Ohmic Resistances in Parallel and Constant Electromotive Force (Allgemeine Lösung des Problems der Parallelschaltung Ohmscher Widerstände und konstanter elektromotorischer Kräfte). Josef Kuhn. Mathematical. Ills. 2800 w. Elek Kraft u Bahnen—Aug. 7, 1910. No. 18086 D.

Frequency Transformer.

An Improved Arrangement for Preventing Brush Sparking in Rotary Electric Frequency Transformers Having Commutators. Illustrated description of a device brought out by Messrs. Siemens Bros. 2200 w. Prac Engr—Oct. 7, 1910. No. 17898 A.

Line Construction.

Discussion on "Transmission Line Crossings of Railroad Rights-of-Way." San Francisco, Cal., May 6, 1910. Discusses Allen H. Babcock's paper. 7500 w. Pro Am Inst of Elec Engrs—Oct., 1910. No. 17990 F.

Line Design.

Approximate Formulae for Transmission-Line Calculations (Annäherungsverfahren bei Berechnung von Fernleitungen). J. Bartok. Derives mathematically a number of simplified formulae. Ills. 5000 w. Elektrotech u Maschinenbau—Sept. 25, 1910. No. 18094 D.

See also Sleet Loads, under TRANSMISSION.

Rotary Converters.

Converters. A detailed description of the various types in use and their applications. 5000 w. Engr, Lond—Oct. 14, 1910. No. 18170 A.

Sleet-Loads.

A Study of Sleet Loads and Wind Velocities. Frank F. Fowle. Deals with an analysis of the Weather Bureau records at Chicago, Ill., giving briefly the history of the Chicago station for the period covered by the study. 3500 w. Elec Wld—Oct. 27, 1910. No. 18181.

Surges.

Experience on the Road. Leonard Work. Describes a mysterious surging of an arc circuit and the cause. 1000 w. Elec Jour—Oct., 1910. No. 17979.

Transformers.

Alternating-Current Transformers. J. Stottner. Illustrates and describes types, and refers to dangerous influences on transformers. 2500 w. Ir & Coal Trds Rev—Oct. 7, 1910. No. 17918 A.

Condenser Type Terminals. A. B. Reynders. An illustrated discussion of the possibilities of this type of insulation. 3000 w. Elec Jour—Oct., 1910. No. 17974.

Discussion on "Observations of Harmonics in Current and in Voltage Wave Shapes of Transformers," San Francisco, Cal., May 6, 1910. Discussion of John J. Frank's paper. 5000 w. Pro Am Inst of Elec Engrs—Oct., 1910. No. 17987 F.

Voltage Drop in Transformers (Spannungsabfall von Transformatoren). Faye-Hansen. A review and discussion of methods of measurement. Ills. 2000 w. Elektrotech u Maschinenbau—Sept. 11, 1910. No. 18090 D.

Voltage Drop of Transformers Having a Poor Regulation. K. Faye-Hansen. Discusses the testing of transformers for voltage drop, urging the use of Prof. Bragstad's method for this purpose. 1500 w. Elect'n, Lond—Sept. 23, 1910. No. 17678 A.

See also Insulating Materials, under MISCELLANY.

MISCELLANY.

Electric Clocks.

Féry Electric Clocks (Horloges électriques Féry). L. Reverchon. Describes their principles and illustrates the apparatus. Serial. 1st part. 1000 w. L'Elecn —Sept. 17, 1910. No. 18011 D.

We supply copies of these articles. See page 487.

Insulating Materials.

Transformer and Switch Insulating Oil. J. Vincent Hunter. Discusses the characteristics and insulating qualities of such oil. 1500 w. Power—Oct. 18, 1910. No. 17926.

Moisture and Impurities in Transformer Oil. J. Vincent Hunter. Explains how to detect and remove moisture and, incidentally, any minor impurities in insulating oils. 1600 w. Power—Oct. 25, 1910. No. 18139.

Magnetos.

See Shop Practice, under MECHANICAL ENGINEERING, MACHINE WORKS AND FOUNDRIES.

INDUSTRIAL ECONOMY.

Apprenticeship.

New York Central Apprenticeship. Fred. H. Colvin. An explanation of a system combining school and shop instruction. Ills. 3500 w. Am Mach—Vol. 33. No. 42. No. 17945.

Training Mechanics in Germany. F. A. Halsey. An explanation of industrial training as understood in Germany. Apprenticeship, as a training for workmen, is the means employed. 5000 w. Am Mach—Vol. 33. No. 43. No. 18184.

Corporations.

The Organization of Great Corporations. William W. Mulford. Discusses the organic and logical basis for the three-column form of organization. 4000 w. Engineering Magazine—Nov., 1910. No. 18258 B.

Cost Systems.

Cost Keeping for Small Machine Shops. Sterling H. Bunnell. Explains a simple card system for keeping accurate cost records. 2500 w. Am Mach—Vol. 33. No. 42. No. 17947.

A Simple Foundry Order System. George Muntz. Describes the application of an economical cost-keeping record in a shop employing 80 molders. 1500 w. Foundry—Oct., 1910. No. 17632.

Education.

The Training and Work of an Electrical Engineer. Murray C. Beebe. On the preparation needed for successful work in this field. 2500 w. Wis Engr—Oct., 1910. No. 17941 C.

The Production of Engineers and Higher Technical Education (La Formation des Ingénieurs et l'Enseignement technique supérieur). Georges Bourrey. Read at the International Congress on Technical Education. Criticizes the methods and ideals of engineering education in France. 3000 w. Rev Gen d Sci—Sept. 30, 1910. No. 18007 D.

Glasgow and West Scotland Technical College. John G. Kerr. Illustrated description of the buildings and their equipment is given in this first instalment. 4800 w. Engng—Sept. 23, 1910. Serial. 1st part. No. 17679 A.

Employers' Liability.

The Application of Legislation on Industrial Accidents in France (L'Application de la Législation sur les Accidents du Travail). An abstract of an official report on the working of the law in 1909. 2700 w. Rev d'Econ Indus—Sept., 1910. No. 18000 D.

Engineering.

The Social Problems of the Engineer (Die sozialen Aufgaben der Techniker). G. Lustig. A review and discussion of the socialogical problems which are presented to the engineer for solution or advice. 5000 w. Zeitschr d Oest Ing u Arch Ver—Sept. 9, 1910. No. 18065 D.

Engineers.

Current Professional Topics. Henry C. Adams. Suggestions for increasing the competency of engineers and preventing unqualified men from pretending they are members of the profession. 7000 w. Soc of Engrs—Oct. 3, 1910. No. 17900 N.

Industrial Betterment.

Betterment of Labor Conditions in the Steel Industry. Address by William B. Dickson before the Am. Ir. & St. Inst. Discusses the prevention of accidents, accident relief, and pension funds. 4000 w. Eng Rec—Oct. 29, 1910. No. 18244.

Labor Exchanges.

Labor Exchanges in France. Editorial review of the aim of these agencies and what they have accomplished. 1800 w. Engng—Oct. 14, 1910. No. 18165 A.

Labor Insurance.

Insurances of Workmen in Germany. Otto Graf. Trans. from *Technik und Wirtschaft*. Discusses the results of the statistics of the laws, particularly those published since 1900. 2800 w. Ir & Coal Trds Rev—Oct. 7, 1910. No. 17917 A.

Compulsory State Insurance of Laborers and Its Improvement (Die staatliche Zwangsversicherung der Handarbeiter und deren Verbesserung). Gg. Jehle. A discussion of labor insurance in Germany. Ills. Serial. 1st part. 1800 w. Giesserei-Zeit—Sept. 1, 1910. No. 18043 D.

The Operation of the Mutual Vocational Insurance Companies in Germany from 1885 to 1910 (Das Wesen und Wirken der gewerblichen Berufsgenossenschaften von 1885 bis 1910). Konrad Hartmann. A review of 25 years of labor insurance in Germany. 3500 w. Tech u Wirt—Sept., 1910. No. 18206 D.

We supply copies of these articles. See page 487.

Management.

Systematic Foundry Operation and Foundry Costs. C. E. Knoeppel. This second article of a series discusses the principal elements of foundry accounting and management. 4500 w. Engineering Magazine—Nov., 1910. No. 18255 B.

The Twelve Principles of Efficiency. Harrington Emerson. This sixth article of a series discusses the fourth principle—discipline. 6000 w. Engineering Magazine—Nov., 1910. No. 18251 B.

The "Outsider" and the Busy Business-Man. William Perry. Suggestions, from experience, as to their proper relations. 3500 w. Engineering Magazine—Nov., 1910. No. 18259 B.

Obtaining the Co-operation of Men. H. F. J. Porter. Discusses the management of labor in industrial works. 2000 w. Am Mach—Vol. 33. No. 41. No. 17879.

Increasing Shop Output. The importance of having "the right man in the right place," the arrangement of the work, and other suggestions. 1800 w. Ry Age Gaz—Oct. 7, 1910. No. 17745.

Patents.

Notes on Patentability (Neue Beiträge zur Lehre von der Patenfahigkeit). Dr. Schanze. A discussion of the fundamental principles of patent law. Serial. 1st part. 5000 w. Glasers Ann—Sept. 1, 1910. No. 18062 D.

Standardization.

Standardization as a Phase in Engineering Evolution. Discusses its place and value. 3500 w. Met & Chem Engng—Oct., 1910. No. 17764 C.

MARINE AND NAVAL ENGINEERING.

British Merchant Marine.

Leading Companies in the British Merchant Marine (Einige der wichtigsten Schiffahrtsgesellschaften auf Aktien in England). Paul Kratz. A review of British merchant shipping, describing in detail some of the more important companies. Serial. 1st part. 4500 w. Schiffbau—Sept. 14, 1910. No. 18051 D.

Dredges.

See Dredging, under MINING AND METALLURGY, GOLD AND SILVER.

Electric Power.

Application of Electricity to Marine Work. Illustrates and describes the equipment of the works of the John N. Robins Company, Erie Basin Dry Docks, Brooklyn, N. Y. 4500 w. Elec Wld—Oct. 6, 1910. No. 17710.

Electro-Magnetic Transmission for Marine Propulsion. Jules Lecoche. Read before the Inst. of Marine Engrs., at Olympia. Explains the difficulties encountered in combining a reciprocating engine with an exhaust steam turbine, and the advantages of the "magnetic gear." Ills. 2000 w. Mech Engr—Sept. 23, 1910. No. 17667 A.

Internal-Combustion Engines.

The Internal-Combustion Engine. William P. Durtnall. Abstract of a paper read before the Inst. of Marine Engrs., at Olympia. Brief review of the development of the internal-combustion engine, describing types and discussing their faults, and efficiency. Ills. 4500 w. Mech Engr—Oct. 7, 1910. No. 17902 A.

Marine Combustion Motors at the International Motor Boat and Motor Exposition at Berlin, 1910 (Boot- und Schiffsmaschinen für flüssigen Brennstoff auf der Internationalen Motorboot- und Motoren-Ausstellung, Berlin, 1910). A. Heller. Illustrates and describes the more important exhibits. 3500 w. Zeitschr d Ver Deutscher Ing—Sept. 3, 1910. No. 18095 D.

Propellers.

On the Number of Ship's Propellers (Du Nombre des Propulseurs sur les Navires). A. Fournier. From the *Revue Maritime*. Discusses the factors governing the choice of the number of propellers in ship design. 2500 w. Rev Indus—Sept. 10, 1910. No. 18013 D.

Salving.

Stranding of Princess May. An illustrated description of the position of the vessel after running on the rocks of the southern Alaska coast, the method of salvage, and the history of the vessel. 1800 w. Marine Rev—Oct., 1910. No. 17847.

The Army Engineers' Report on Raising the "Maine." Gives important sections of the report and the proposed method of raising the wreck, and recommendations relating to the work. 3000 w. Eng News—Oct. 20, 1910. No. 17958.

Raising the United States Battleship "Maine." Plans and description of methods adopted for exposure of the wreck by a cofferdam of interlocking sheet pile cylinders of steel. 3000 w. Eng Rec—Oct. 22, 1910. No. 18112.

Ship Designs.

The Growth of Steamships. Sir William H. White. Condensed from *London Times Engng. Sup.* A discussion of the tendencies in ship construction believing the future will be governed by commercial considerations. Also editorial. 2500 w. Eng News—Oct. 6, 1910. No. 17719.

The Revolution in Cargo Vessels and Its Influence on Rolling Mills (Die Umwälzung im Handelsschiffbau und ihr

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Einfluss auf die Profilwalzwerke). Carl Kielhorn. Discusses the new sections which have been developed to meet the demands of naval architecture. 2000 w. Stahl u Eisen—Sept. 14, 1910. No. 18036 D.

Beam Profiles (Balken-Profile). Arthur R. Liddell. A criticism of the inadequacy of the German structural shapes to the requirements of shipbuilding. Ills. 2500 w. Schiffbau—Sept. 28, 1910. No. 18052 D.

Column Tables for Ship Work. R. Earle Anderson. A review of information relative to column strength, and the conclusions drawn therefrom. 2500 w. Int Marine Engng—Oct., 1910. Serial. 1st part. No. 17692 C.

Ship's Boats.

Life Saving at Sea. Sydney F. Walker. Explains the difficulties in lowering and disengaging boats at sea, discussing davits, and disengaging apparatus. Ills. 2500 w. Int Marine Engng—Oct., 1910. No. 17690 C.

Steamships.

Old American Transatlantic Steam Liners. Francis B. C. Bradlee. An illustrated account of early attempts of transatlantic steam navigation and of the various lines started by Americans. 4500 w. Int Marine Engng—Oct., 1910. Serial. 1st part. No. 17693 C.

New American-Hawaiian Steamers. Illustrated descriptions of three of the best type of American merchant cargo vessels, carrying a limited number of passengers. 1200 w. Int Marine Engng—Oct., 1910. No. 17689 C.

The Portuguese Royal Mail Steamer Lisbon. Illustrated description of a twin screw passenger and mail steamer for service between Portugal and Africa. 1200 w. Int Marine Engng—Oct., 1910. No. 17694 C.

The French Atlantic Liner France. Illustrated descrintion of the largest mercantile vessel yet built in a French yard. 2000 w. Engr, Lond—Oct. 14, 1910. No. 18173 A.

The Launch of the Olympic. Illustrates and describes particulars concerning the machinery of this large vessel, recently launched. Plate. 1800 w. Engr, Lond—Oct. 21, 1910. No. 18301 A.

The White Star Liner "Olympic." Illustrated description of this large liner, its construction, and equipment. Plates. 9500 w. Serial. 1st part. Engng—Oct. 21, 1910. No. 18296 A.

See also Steam Turbines, under MARINE AND NAVAL ENGINEERING.

Steam Turbines.

Turbine Troubles. Especially considers blading troubles and their causes. 3000 w. Engr, Lond—Oct. 21, 1910. No. 18300 A.

The Brown-Curtis Turbine Installation in H. M. S. "Bristol." An illustrated description and review of the performance of this vessel on her trials. Plates. 5000 w. Engng—Sept. 30, 1910. No. 17831 A.

The First Italian Turbine Passenger Steamer. Dagnino Attilio. Illustrates and describes the machinery of the "Citta Di Catania," the first Italian steamer fitted with turbine machinery constructed in Italy. 1200 w. Int Marine Engng—Oct., 1910. No. 17691 C.

Submarines.

Submarines. Simon Lake. Reviews the development, giving accounts of the early vessels of this type and the difficulties encountered. Ills. Discussion. 7500 w. Pro Engrs' Club of Phila, No. 1089—Oct, 1910. No. 18248 D.

The Norwegian Submersible "Kobben" and the Submersibles of the "Germania" Type (Le Submersible Norvégien "Kobben" et les Submersibles du Type "Germania"). Brief illustrated review. 1200 w. Génie Civil—Sept. 24, 1910. No. 18021 D.

Yachts.

Twin-Screw Yacht Lien-Ching. Engraving, drawings and description of a steam yacht of 500-tons displacement. 800 w. Engr, Lond—Oct. 7, 1910. No. 17911 A.

A Shallow Draft Yacht. Plan and detailed description of a triple-screw, shallow-draft tunnel yacht. 1000 w. Int Marine Engng—Nov., 1910. No. 18396 C.

MECHANICAL ENGINEERING.

AUTOMOBILES.

Adams.

New Cars for 1911. Brief illustrated description of the new 16 h.p. Adams car. 1000 w. Auto Jour—Oct. 15, 1910. No. 18149 A.

Argyll.

Argyll. Illustrated description of the 12 h.p. new model for 1911. 1000 w. Auto Jour—Oct. 1, 1910. No. 17802 A.

Chadwick.

The Chadwick for 1911. Four new models, mechanically identical, are illustrated and described. 2500 w. Automobile—Oct. 20, 1910. No. 17964.

Colors.

Automobile Colors. M. C. Hillick. Remarks on popular colors and the methods of applying them. 1000 w. Automobile—Oct. 6, 1910. No. 17733.

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Crossley.

The 12-14 h.p. and 20 h.p. Crossley Cars. Illustrated description of new features introduced in the latest types of these cars. 1000 w. Autocar—Oct. 15, 1910. No. 18146 A.

Daimler.

Next Year's Daimlers. Illustrated detailed description of the new 12 h.p. chassis, and features of interest. 1500 w. Autocar—Sept. 24, 1910. No. 17661 A.

New Cars for 1911. Interesting features of the new Daimler cars are illustrated and described. 1500 w. Auto Jour—Sept. 24, 1910. No. 17662 A.

Electric.

Electric Vehicles of the New Oberschöneweide Automobile Company (Elektrische Motorwagen der Neuen Automobil-Gesellschaft in Oberschöneweide bei Berlin). Herr Dierfeld. Brief description of these new cars. Ills. 1200 w. Zeitschr d Ver Deutscher Ing—Sept. 17, 1910. No. 18202 D.

Elmore.

Two-Cycle Elmore. Illustrates and describes "Model 25," made in two types, also improved features of other models. Ills. 3500 w. Automobile—Oct. 6, 1910. No. 17735.

Engineering.

The Automobile. Hermann F. Cuntz. A review of the rapid development, discussing some of the problems and their solution and the field for the mechanical engineer. 6500 w. Stevens Ind—Oct., 1910. No. 17731 D.

Franklin.

Franklin Product and Practices. Illustrates and describes air-cooled motors, methods of manufacture, etc. 1500 w. Automobile—Oct. 27, 1910. No. 18229.

Gears.

Worm Gearing. J. Dalrymple Bell. Discusses the possibilities of a change-speed gearing with helical teeth giving two or more direct drives. Ills. 1500 w. Autocar—Oct. 1, 1910. No. 17804 A.

Ignition.

Double Ignition by Magneto. Illustrated description of a novel two-pole Bosch machine. 1500 w. Auto Jour—Oct. 8, 1910. No. 17890 A.

Lighting.

Electric Light for Cars. Illustrations and outline of the new C. A. V. system for car lighting. 1400 w. Autocar—Sept. 24, 1910. No. 17660 A.

Popularizing Electric Light for Cars. Illustrated description of the latest C. A. V. system. 3000 w. Auto Jour—Oct. 1, 1910. No. 17803 A.

Motor Balancing.

The Balancing of Engines. F. Strickland. Discusses points to be considered, especially the influence of the angle of the connecting rod. 1200 w. Autocar—Oct. 8, 1910. No. 17889 A.

Motor Crank Shafts.

Four-Cylinder Crank Shaft Design. P. M. Heldt. Derives formulae for dimensioning crank shafts for motor car engines from data obtained from actual modern engines. Ills. 800 w. Horseless Age—Oct. 19, 1910. Serial. 1st part. No. 17993.

Motors.

Fresh Fields of Engine Development. Illustrates and describes the novel features possessed by an engine designed by C. Leslie Walker. 2500 w. Auto Jour—Sept. 24, 1910. No. 17663 A.

Novel Two-Cycle Motor. Illustrates and describes Leslie Walker's design of an internal combustion engine which is a new departure in automobile practice. 2000 w. Automobile—Oct. 13, 1910. No. 17852.

The F. H. S. Double Impulse Engine. Illustrates and describes a two-stroke engine embodying new features aiming toward increased efficiency. 1500 w. Autocar—Oct. 15, 1910. No. 18148 A.

The Hewitt Piston Valve Engine. Brief illustrated description of the cycle of operations. 600 w. Autocar—Oct. 15, 1910. No. 18147 A.

Motor Valves.

Some Criticisms of the Slide Valve Engine. Mainly a critical comparison of the slide and poppet systems, by a manufacturer of poppet valve engines. 3500 w. Autocar—Oct. 15, 1910. No. 18145 A.

Rambler.

Rambler Line for 1911. Illustrates and describes features of the output, which includes nine styles, detachable fore-doors, etc. 2500 w. Automobile—Oct. 6, 1910. No. 17732.

Selden.

Selden Mechanically for 1911. Illustrated detailed description of the motor used in the five models. 1500 w. Automobile—Oct. 6, 1910. No. 17734.

Tires.

Care and Repair of Tires. Discusses the expense and importance of the tire problem, giving suggestions and precautions. Ills. 2000 w. Automobile—Oct. 27, 1910. No. 18228.

Sectional Tire Construction. Brief illustrated description of the Margett sectional pneumatic tire. 1500 w. Auto Jour—Oct. 15, 1910. No. 18150 A.

Traction Engines.

Tests of Traction Engines at Winnipeg, Canada. Tabulated results, with explanatory notes. 1500 w. Eng News—Oct. 27, 1910. No. 18194.

Combination Gasoline Traction Engine with Ditcher Wheel Attachment. Frank C. Perkins. Illustrated description of a machine of American construction. 1000 w. Sci Am—Oct. 29, 1910. No. 18236.

Transmissions.

See Gears, under MACHINE ELEMENTS AND DESIGN.

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COMBUSTION MOTORS.

Aeronautic Motors.

Aviation and Aeroplane Motors. Henri Petit. Trans. from *La Nature*. Detailed analysis of the essential features of the power plant equipment suggesting a probable solution of the problems of future development. Ills. 2000 w. Jour Fr Inst—Oct., 1910. No. 17936 D.

The Testing of Aeronautic Motors (Les Essais des Moteurs d'Aviation). A. Boyer-Guillon. Discusses purpose, apparatus, and methods. 2000 w. Rev de Mécan—Sept., 1910. No. 18004 E + F.

Gas Cleaning.

The Necessity of Thoroughly Cleansing Producer Gas. L. L. Brewster. Gives some results of inadequate cleaning and suggests a form of sprayer for use in the wet scrubber. 1500 w. Power—Oct. 4, 1910. No. 17653.

See also Blast-Furnace Gas, under MINING AND METALLURGY, IRON AND STEEL.

Gas-Engine Efficiency.

The Advance of Gas Engines. G. A. Julius. Abstract of paper read before the Engng. Assn. of N. S. W. A discussion of their commercial efficiency. 4500 w. Aust Min Stand—Sept. 21, 1910. Serial. 1st part. No. 18143 B.

Gas-Engine Governors.

Modern Governing Mechanisms. Warren H. Miller. Illustrates and describes various types of gas-engine governors. 1500 w. Power—Oct. 18, 1910. No. 17925.

Gas Engines.

The Development of Large Gas Engines. Remarks on the remarkable development during the last ten years, and information concerning the industries using them. Diagrams. 3000 w. Ir & Coal Trds Rev—Oct. 14, 1910. No. 18174 A.

Cooling Gas Engines. George J. Murdock. Illustrated description of a new cooling device and its operation, claiming great economy. 2000 w. Mach, N Y—Oct., 1910. No. 17646 C.

Gasoline Engines.

The Petrol Engine. Prof. W. Watson. Describes briefly some typical forms introductory to a discussion of the principles common to all petrol engines. Ills. 6500 w. Jour Soc of Arts—Sept. 23, 1910. Serial. 1st part. No. 17658 A.

Gas Power Plants.

A Small Power Plant with Modern Features. L. L. Brewster. Illustrated description of a 500-h.p. modern gas engine plant, with bituminous producers. 1600 w. Power—Oct. 11, 1910. No. 17793.

The Performance of a Gas Engine and Suction Producer Plant, Engaged in Public Lighting Work in South Africa. Harry W. Miller. Gives results achieved with a plant for generating electric energy for lighting the town of Bethlehem, in the Orange Free State. Also discussion. 5800 w. Jour S African Assn of Engrs—Aug., 1910. No. 17659 F.

See also Central Stations, under ELECTRICAL ENGINEERING, GENERATING STATIONS.

Gas Producers.

Recent Progress in the Construction of Suction Gas Producers. R. W. Hilgenstock. Brief description of two new producers and results obtained. Ills. 1200 w. Am Gas Lgt Jour—Oct. 10, 1910. No. 17788.

New Producers for Bituminous Coal (Neuere Generatoren für bituminöse Brennstoffe). Herr Gwoodz. Describes in detail recent types. Ills. Serial. 1st part. 3000 w. Glückauf—Sept. 17, 1910. No. 10849 D.

Oil Engines.

Oil Engines Driving Centrifugal Pumps in the Copenhagen Water Works (Dieselmotoren mit Kreiselpumpen im Wasserwerk der Stadt Kopenhagen). A. Olivarius. Illustrated description of the installation. Serial. 1st part. 1200 w. Zeitschr f d Gesamte Turbinenwesen—Sept. 20, 1910. No. 18059 D.

See also Central Stations, under ELECTRICAL ENGINEERING, GENERATING STATIONS.

HEATING AND COOLING.

Air Purification.

The Mechanical Purification of Air. C. L. Browne. Describes apparatus for filtering and washing air. Ills. 4000 w. Cassier's Mag—Oct., 1910. No. 17698 B.

Cooling Towers.

The Theory of the Cooling Tower. Joseph H. Hart. Shows how the cooling effect is obtained by absorption, condensation, convection, and radiation. 2500 w. Power—Oct. 4, 1910. No. 17650.

Hot-Air Heating.

School Fan Furnace-Heating Plant. Plans and description of an installation using both a plenum and an exhaust fan. 1500 w. Met Work—Oct. 8, 1910. No. 17765.

Refrigeration.

The Absorption Refrigerating System. F. E. Matthews. Illustrates and describes the various elements of this system. 2500 w. Power—Oct. 25, 1910. No. 18137.

Types of Ammonia Compressors. F. E. Matthews. Illustrates and describes typical examples of double and single acting ammonia compressors. 1000 w. Power—Oct. 4, 1910. No. 17649.

Refrigeration in the Blackstone Hotel. Illustrated general description of the refrigerating plant and air-cooling system of a large Chicago hotel. 2000 w. Ice & Refrig—Oct., 1910. No. 17688 C.

The Municipal Abattoir at Paris, Texas. Description and views of plant and equipment, including the refrigerating plant. 2000 w. Ice & Refrig—Oct., 1910. No. 17687 C.

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A Novel Refrigerating Plant in a French Mine. Dr. Alfred Gradenwitz. Illustrates and describes a plant recently installed at mines of Béthune, France. 1500 w. Min Wld—Oct. 15, 1910. No. 17882.

Steam Heating.

Heating and Ventilating a Ten-Story Bank Building. Illustrated description of the system of heating and ventilation adopted for the Boston Safe Deposit and Trust Co. A combination of the Webster "modulation" direct heating and the indirect fan heating system. 1500 w. Heat & Vent Mag—Oct., 1910. No. 18129.

See also Exhaust Steam, under STEAM ENGINEERING.

Ventilation.

Hygienic Principles of Ventilation. W. A. Evans, in the *Medical Rec.* Enumerates important features of improving indoor air conditions. 2500 w. Met Work—Oct. 22, 1910. No. 17991.

HYDRAULIC MACHINERY.

Air Lift.

Air Lift Pumping. Edward A. Rix, in *The Oil Industry.* Explains general terms used, giving diagrams, tables, formulae and information. 1200 w. Min & Sci Pr—Oct. 15, 1910. No. 17997.

Centrifugal Pumps.

Recent Developments in Centrifugal Pumps (Neuere Ausführungen von Kreiselpumpen). Ernst Blau. Describes and reports the performance of a number of large, high-lift units for mining work. Ills. 1000 w. Zeit d Oest Ing u Arch Ver—Sept. 23, 1910. No. 18066 D.

See also Oil Engines, under COMBUSTION MOTORS.

Hydrodynamics.

Experiments on the Conversion of Water Velocity into Pressure (Versuche über die Umsetzung von Wassergeschwindigkeit in Druck). K. Andres. Describes the test apparatus and gives the results. Ills. Serial. 1st part. 3300 w. Zeitschr d Ver Deutscher Ing—Sept. 17, 1910. No. 18201 D.

Hydrodynamo.

The Fallacy of the Hydrodynamo. The device is illustrated and described and its fallacy pointed out. 800 w. Power—Oct. 18, 1910. No. 17923.

Pump Design.

Notes on the Design of Reciprocating Pumps. A. Marshall Attack. Discusses points that affect the choice of design, and details of different types. Ills. 1200 w. Mech Wld—Oct. 7, 1910. Serial. 1st part. No. 17903 A.

Pumping Plants.

The Salt Lake Sewage Pumping Station. Illustrated detailed description of a station equipped with a duplicate power and pumping outfit. A gas-producer outfit and an electric installation inter-connected to the two pumping units insure constant operation. 900 w. Eng Rec—Oct. 8, 1910. No. 17774.

See also Pumping, under MINING AND METALLURGY, MINING.

Turbine Buckets.

A Graphical Method of Designing Turbine Buckets (Kreis-Trajektorien, ein Ersatz für exakte Stromfunktionen). Johannes Lüttmann. Describes a method of designing turbine buckets by geometrical construction. Ills. Serial. 1st part. 1500 w. Zeitschr f d Gesamte Turbinenwesen—Sept. 10, 1910. No. 18058 D.

Valves.

The Largest Valves in the World. Illustrated description of the 9-foot gate valves for the control of hydraulic turbines of 12000-h.p. each, made for the Ontario Power Co. 800 w. Am Mach—Vol. 33. No. 42. No. 17943.

MACHINE ELEMENTS AND DESIGN.

Ball Bearings.

The Friction of Ball Bearings. Trans. from *La Vie Automobile.* An illustrated account of experimental investigations. 1500 w. Prac Engr—Sept. 23, 1910. Serial. 1st part. No. 17825 A.

Clutches.

On the Design of Multiple Disc Clutches. Eugene P. Batzell. Gives a diagram intended for the quick determination of suitable dimensions for such clutches, with formulae and methods. 3500 w. Horseless Age—Oct. 12, 1910. No. 17877.

Drawings.

Photographic Reproduction of Drawings (Photographische Reproduktionen von Zeichnungen). Werner Ahrens. Discusses methods of filing and indexing photographic reproductions of working drawings. Ills. 2200 w. Tech u Wirt—Sept., 1910. No. 18207 D.

Gears.

Gear Tooth Standards and Comparisons. Diagrams, tables, and explanatory notes. 500 w. Engr, Lond—Oct. 14, 1910. No. 18171 A.

Design of Automobile Transmission Gears. M. Terry. Discusses some of the main principles common to all gear transmissions. 3000 w. Mach, N Y—Oct., 1910. Serial. 1st part. No. 17636 C.

Gyroscope.

A New Theory of the Gyroscope and Its Practical Application (Eine neue Theorie des Kreisels und seine Anwendung in der Technik). A. Fuchs and R. Katzmayr. Presents a simple theory of the action of the gyroscope and outlines practical applications. Ills. Serial. 1st part. 7200 w. Zeitschr d Ver Deutscher Ing—Sept. 10, 1910. No. 18098 D.

Riveted Joints.

The Strength of Spiral Riveted Joints. John Jasky. Mathematical determination.

We supply copies of these articles. See page 487.

700 w. Boiler Maker—Oct., 1910. No. 17753.

Vice.

An Improved Vice. The invention of R. W. & L. H. Bateman of Leeds, is illustrated and described. 800 w. Prac Engr—Sept. 23, 1910. No. 17665 A.

MACHINE WORKS AND FOUNDRIES.

Brass Founding.

Brass Foundry Progress. Charles T. Bragg. Read before the Am Brass Found.'s Assn. Reports the development, and the value of chemical control. 1200 w. Foundry—Oct., 1910. No. 17634.

Yellow Brass Chips and Their Relation to the Manufacture of Brass Ingot. Information concerning brass chips and the contaminating material found in them. Ills. 1000 w. Brass Wld—Oct., 1910. No. 17970.

Why Crucibles Often Fail. Walter J. May. Brief explanation of causes. 700 w. Prac Engr—Oct. 7, 1910. No. 17899 A.

See also Metallography, under MATERIALS OF CONSTRUCTION.

Casehardening.

Casehardening for Colors. E. R. Markham, in *Southern Machinery*. Gives methods of producing colors on iron and steel. Ills. 1600 w. Mech Engr—Sept. 30, 1910. No. 17828 A.

Castings.

Iron Castings: Defects and Remedies. Robert Job. Read before the Canadian Ry. Clubs. Discusses causes of hardness and the remedy, porous, spongy iron, and other defects. 2000 w. Can Engr—Oct. 13, 1910. No. 17875.

Chip Briquetting.

The Briquetting of Metal Chips (Die Brikettierung von Eisen- und Metallspänen). Erich Schumacher. Describes the Ronay process and gives some results. Ills. 1500 w. Giesserei-Zeit—Sept. 15, 1910. No. 18044 D.

Dies.

Out-of-Date Die-Making Methods. Critical comments on an article by F. E. Shailor in the June issue, on this subject. 3800 w. Mach, N. Y—Oct., 1910. No. 17645 C.

Bending Dies for the Ribbon Forks of the Ellis Adding Typewriter. Ralph E. Flanders. Illustrates and describes tools used and their action. 1500 w. Mach, N Y—Oct., 1910. No. 17640 C.

Drilling Machines.

A High Powered Close Drive. John Squires. Brief illustrated description of a drill drive of high power, where compactness was important. 800 w. Am Mach—Vol. 33. No. 42. No. 17944.

Foundries.

Typical Modern Foundry Layouts. First of a series of articles illustrating and describing the general arrangement and equipment of gray iron foundries of varying capacities. 1200 w. Foundry—Oct., 1910. Serial. 1st part. No. 17628.

The Mesta Machine Company's Foundry. Plans, sections and general description of this foundry at Pittsburgh, Pa. 1200 w. Eng Rec—Oct. 8, 1910. No. 17771.

A Large Milwaukee Steel Casting Plant. Illustrated description of the equipment and arrangement of the Falk Co.'s foundry, using the open-hearth process. 1500 w. Foundry—Oct., 1910. No. 17631.

Casting Large Propellers in Monel Metal. Illustrated description of work at a plant in Bayonne, N. J., devoted exclusively to the melting of this comparatively new alloy of nickel and copper. 1200 w. Foundry—Oct., 1910. No. 17633.

Foundry Buildings.

Foundry Buildings (Giessereihallenbauten). R. Lots. Discusses the influence of temperature variations on buildings. Serial. 1st part. 1800 w. Giesserei-Zeit—Sept. 1, 1910. No. 18040 D.

Foundry Furnaces.

The Electric Furnace: Its Utility for Castings. W. S. Gifford. Abstract of paper before the British Found. Assn. A brief review of what has been accomplished in this application. 1000 w. Elec Engr, Lond—Sept. 23, 1910. No. 17674 A.

The Design of Reverberatory Furnaces for Foundries (Giessereiflammöfen und ihre Berechnung). Bernhard Osann. Describes their design, calculation of charge, and operation. Ills. 5200 w. Stahl u Eisen—Sept. 7, 1910. No. 18034 D.

Muffle Furnaces for Enamelling and other Purposes (Muffelöfen für Emaillierwerke und andere industrielle Zwecke). Ernst A. Schott. Describes a number of types. Ills. 5200 w. Stahl u Eisen—Sept. 7, 1910. No. 18035 D.

Foundry Materials.

The Valuation of Pig Iron. J. H. Linton. Shows that the value depends on the chemical composition. 1200 w Foundry—Oct., 1910. No. 17630.

Foundry Practice.

Car Wheel Foundry Practice: Canadian Pacific. George L. Fowler. Illustrated description of the foundry, its equipment, methods and results. 4500 w. Ry Age Gaz—Oct. 7, 1910. No. 17748.

Furnaces.

The Hawley Automatic Annealing Furnace. Illustrates and describes a recent model in which electric motors control all operations. 1500 w. Ir Age—Oct. 20, 1910. No. 17995.

The Introduction of the Gas Furnace. Charles F. Stamps. Read before the Pacific Coast Gas Assn. Brief consideration of the general principles of construction, and the causes of their slow development. 1200 w. Am Gas Lgt Jour—Oct. 10, 1910. No. 17789.

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Galvanizing.

Galvanizing Malleable Castings (Verzinkung von Tempergussstücken). O. Beckmann. A brief review of methods and apparatus. Ills. Serial. 1st part. 1600 w. Giesserei-Zeit—Sept. 1, 1910. No. 18041 D.

Gear Cutting.

Making Hindley Worm Gears. Charles H. Logue. An account of an experience in cutting Hindley worm gears that showed the points of interference. 1800 w. Am Mach—Vol. 33. No. 43. No. 18185.

Grinding.

Grinding Reamers and Milling Cutters. George W. Burley. The present number considers mainly the disc wheel and its use. 1500 w. Mech Wld—Sept. 23, 1910. Serial. 1st part. No. 17671 A.

Grinding Machines.

The Blanchard Vertical Spindle Surface Grinder. Description of a machine combining great power and accuracy. Ills. 2500 w. Ir Age—Oct. 13, 1910. No. 17837.

Lathes.

Comparisons Between English and American Lathe Design. G. W. Burley. Read before the Sheffield Soc. of Engrs. & Met. A comparison and discussion of practice and design in the two countries. 2500 w. Mech Wld—Oct. 7, 1910. No. 17904 A.

Two Large Double-Bedded Lathes. Illustrates and describes two lathes of unusual proportions, built in Manchester, England. 700 w. Engr, Lond—Sept. 30, 1910. No. 17834 A.

The Calculation of Step Pulleys for Ruppert Drive (Zeichnerische Bestimmung der Stufenräder für Ruppertgetriebe). Hans Volkmann. Mathematical discussion of the design of speed-changing gears for this type of drive. Ills. 3000 w. Zeitschr f Werkzeug—Sept. 5, 1910. No. 18063 D.

Machine Tools.

Depreciation of Machine Tools. W. W. Bird. Discusses the factors, analyzing the problem from the second-hand dealer's point of view, and offering suggestions. 3000 w. Am Mach—Vol. 33. No. 43. No. 18186.

Suggestions to Users of Machine Tools. A. J. Larmon. Urges the necessity of leveling machines, especially across the shears before bolting them to the floor, and of trying them after several months operation. Other useful suggestions. 1000 w. Ir Age—Oct. 6, 1910. No. 17750.

Special Automobile Tool Equipment. T. A. Sperry. Illustrates and describes methods employed in building the Marmon cars. 1200 w. Am Mach—Vol. 33. No. 40. No. 17707.

Milling.

Milling Cutter Practice at the Juniata Shops. Ralph E. Flanders. Illustrates and describes points in cutter practice. 1500 w. Mach (Ry Ed)—Oct., 1910. No. 17801 C.

See also Grinding, under MACHINE WORKS AND FOUNDRIES.

Molding.

Pattern and Mold for Odd Shape. Joseph G. Horner. Describes the building of the pattern, core box, and mold for an unusual shaped casting. Ills. 1500 w. Am Mach—Vol. 33. No. 40. No. 17709.

Molding Machines.

Bonvellain and Ronceray's Patent Universal Machine-Moulding System. Illustrated detailed description of this system, the moulding machines and appliances used. Plates. 6000 w. Engng—Oct. 14, 1910. No. 18164 A.

Molding Sand.

A Screenless Ball Mill for Foundries (Sieblose Kugelmühle mit Windsichtung für Giessereizwecke). Friedr. Meyer. Describes a new type of mill for the preparation of molding sand. Ills. 2000 w. Giesserei-Zeit—Sept. 15, 1910. No. 18042 D.

Planers.

The Knecht Rapid Production Planer. Illustrates and describes a planer with many novel features. 3500 w. Am Mach—Vol. 33. No. 40. No. 17706.

Pneumatic Tools.

The Hessenmüller Pneumatic Hammer with Oscillating Cylinder (Luftfederhammer mit bewegtem Zylinder, Bauart Hessenmüller). U. Lohse. Illustrated detailed description. 3500 w. Zeitschr d Ver Deutscher Ing—Sept. 17, 1910. No. 18200 D.

Shop Accidents.

Prevention of Accidents in the Shop. Gives hints suggested by the Fidelity and Casualty Co., New York. 2500 w. Ry Mas Mech—Oct., 1910. Serial. 1st part. No. 17851.

Shop Lighting.

Illumination as a Factor in Manufacturing Costs. A. S. Hubbard. Extract from a paper read before the Nat. Assn. of Cotton Mfrs. Remarks on the eye and its functions and the general conditions of light affecting its use, especially presenting the advantages claimed for the Cooper Hewitt lamps. 3800 w. Elec Rev, N Y—Oct. 1, 1910. No. 17599.

Shop Practice.

Automobile Factory Practice. Ethan Viall. Illustrates and describes methods used at the works of Haberer & Co., Cincinnati, Ohio. 1200 w. Mach, N Y—Oct., 1910. No. 17639 C.

Machining a Motor Fly-Wheel. Edward J. Blanchard. Illustrates and describes machining on a No. 3-A Potter & Johnston automatic turret machine. 2000 w. Mach, N Y—Oct., 1910. No. 17641 C.

Making Automobile Radiators. Ethan Viall. Illustrated detailed description of

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methods used for the perforated fin-and-tube type. 800 w. Mach, N Y—Oct., 1910. No. 17637 C.

Examples of Modern Turning Practice in Automobile Construction. Illustrates and describes interesting examples. 2000 w. Mach, N Y—Oct., 1910. No. 17642 C.

Making Roller Bearings. Ethan Viall. Illustrations, with explanatory notes. 500 w. Mach, N Y—Oct., 1910. No. 17644 C.

Making Pneumatic Tube Sections. F. A. Stanley. Illustrates and describes methods of boring, milling, drilling, and grinding cast-iron pipe sections of various shapes. 2000 w. Am Mach—Vol. 33. No. 42. No. 17946.

The Operation and Manufacture of Magnetos. Harold Whiting Slauson. The present number explains the principles of a number of types of magneto generators. 2500 w. Mach, N Y—Oct., 1910. Serial. 1st part. No. 17638 C.

Shop Kinks. Illustrates and describes devices and methods used in a number of shops. 800 w. Ry Age Gaz—Oct. 7, 1910. No. 17749.

Shops.

The Works of Escher Wyss & Co. F. R. Low. Illustrations and descriptive notes on the construction of Zoelly turbines, rotary air compressors and water wheels. 2000 w. Power—Oct. 25, 1910. No. 18135.

Tempering.

Safety in Hardening Large Die Blocks. C. U. Scott. Illustrates and describes a method of handling which avoids risks and produces uniformly satisfactory results. 2500 w. Ir Trd Rev—Oct. 20, 1910. No. 17962.

Welding.

Autogenous Welding. Henry Cave. History and description of the process and its applications. Ills. 1000 w. Yale Sci M—Oct., 1910. No. 18224 C.

Electric Butt Welding. A. E. Buchenberg. General discussion of electric butt welding as opposed to brazing and the ordinary forge method of lap welding with particular reference to shop requirements. Ills. 3500 w. Mach, N Y—Oct., 1910. No. 17643 C.

Electric Welding (L'Assemblage des Pièces métalliques à l'Aide du Courant électrique). Bruno Loewenherz. Describes an electric-welding machine and illustrates many applications. 2000 w. L'Elecn—Sept. 10, 1910. No. 18009 D.

MATERIALS OF CONSTRUCTION.

Alloys.

Some Common Defects Occurring in Alloys. Cecil H. Desch. Read before the Inst. of Metals. Classifies some common defects discussing their causes. 4000 w. Mech Engr—Sept. 30, 1910. No. 17829 A.

Linotype, Monotype, Stereotype and Electrotype Metals and Their Manufacture. Discusses their making from new metals, and from old metals. Ills. 1200 w. Brass Wld—Oct., 1910. No. 17972.

The Pyrophoric Alloys and Their Employment in the Manufacture of Modern Tinder Boxes (Les Alliages pyrophoriques et leur Emploi dans la Fabrication des Briquets modernes). Richard Böhm and Paul Nicolardot. Describes various alloys and the apparatus made from them. Ills. 2500 w. Génie Civil—Sept. 17, 1910. No. 18020 D.

See also Foundries, under MACHINE WORKS AND FOUNDRIES.

Brass.

The Heat-Treatment of Brass. G. D. Bengough and O. F. Hudson. Read before the Inst. of Metals. A study of the effects of heat-treatment on rolled and drawn 70:30 brass of varying size of section. 4500 w. Engng—Sept. 23, 1910. No. 17680 A.

Carborundum.

Metallic Silicides: The Action of Carbide of Silicon on Certain Metallic Oxides (Siliciures métalliques: Action du Carbure de Silicium sur quelques Oxydes métalliques). L. Baraduc-Muller. Reports an exhaustive research on the chemical stability of carborundum. Ills. 75000 w. Rev de Métal—Sept., 1910. No. 18003 E + F.

Cast Iron.

The Physical Properties of Cast Iron. John Jermain Porter. Read before the Am. Found. Assn. A discussion of the static and dynamic strength of gray iron, its elastic properties, grain structure, etc. 5000 w. Foundry—Oct., 1910. Serial. 1st part. No. 17629.

The Influence of Silicon on Pure Cast Iron. Arthur Hague and Prof. Thomas Turner. Read before the Iron & Steel Inst. An experimental study of the effect of varying proportions of silicon on the volume and temperature changes, during the cooling of a pure high-carbon iron alloy. Ills. 5000 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17813 A.

Manganese in Cast Iron and the Volume Changes During Cooling. H. I. Coe. Read before the Iron & Steel Inst. An account of research work dealing with the effect of manganese on white iron and on gray iron. Ills. 10800 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17810 A.

Copper.

The Influence of Impurities on the Properties of Copper. F. Johnson. Notes on the effects of arsenic, lead, nickel, bismuth, cobalt, antimony, tellurium, iron, tin, silver, sulphur, oxygen, etc., with micrographs. 5000 w. Met & Chem Engng—Oct., 1910. No. 17760 C.

Fatigue.

Some Experiments on Fatigue of Metals. J. H. Smith. Read before the Iron & Steel Inst. An illustrated account of a series of experiments upon the fatigue of

metals carried out in Belfast. 11000 w. Ir & Coal Trd Rev—Sept. 30, 1910. No. 17818 A.

Metallography.

Sulphurous Acid as a Metallographic Etching Medium. S. Hilpert and E. Colver-Glauert. Read before the Iron & Steel Inst. Reports researches and results obtained with this reagent. Ills. 2500 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17811 A.

Theory of Hardening Carbon Steels. C. A. Edwards. Read before the Iron & Steel Inst. Discusses the subject with the hope of merging the theories of the "carbonist" and the "allotropist" and sinking the difference which now exists. Ills. 6500 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17812 A.

Metallography in the Brass Foundry. H. S. Primrose. Read before the Inst. of Metals. An illustrated article discussing cases in workshop practice in which examination of defective castings has been useful in discovering the causes of the defects. 3500 w. Foundry—Oct., 1910. No. 17635.

Silver.

Blistering of Sterling-Silver During Annealing. Describes methods of annealing silver and the causes of blister. Ills. 1000 w. Brass Wld—Oct., 1910. No. 17971.

MEASUREMENT.

File Testing.

The Testing of Files. Prof. W. Ripper. Read before the British Assn. Outlines an investigation of results of tests made on the Hubert file-testing machine, which led to improvements in the machine. Also editorial. Ills. 3000 w. Mech Engr—Sept. 23, 1910. No. 17668 A.

Gages.

A New System of Screw Limit Gages. William Taylor. Considers the defects of the common form of gage and illustrates and describes the Taylor screw gage. 1000 w. Am Mach—Vol. 33. No. 41. No. 17880.

Hardness.

Hardness and Its Measurement. G. A. Roush. A comparison of hardness data and other physical tests on the alloys of nickel, copper, and Monel metal with electrolytic iron. 1500 w. Met & Chem Engng—Oct., 1910. No. 17761 C.

Scleroscope Tests for Hardness (Die Kugelfallprobe). John J. Schneider. Discusses the scleroscope method of hardness testing, the significance and accuracy of the results, etc. Ills. 6000 w. Zeitschr d Ver Deutscher Ing—Sept. 24, 1910. No. 18204 D.

Spectroscope.

Auto-Collimating Prism and Spectrograph. Prof. C. Féry. Illustrated description of the instrument. 1500 w. Engng—Oct. 7, 1910. No. 17910 A.

Units.

New Units in Aero-physics. Alexander McAdie. Discusses the need of new units for the measurement of atmospheric pressure, temperature, humidity, etc. 2000 w. Am Jour of Sci—Oct., 1910. No. 17930 D.

Water.

Flow Measurement by Means of the Pitot Tube. Shows the value of the Pitot tube as a gauging instrument, giving explanation of its use. Ills. 1200 w. Surveyor—Oct. 14, 1910. No. 18160 A.

POWER AND TRANSMISSION.

Air Compressors.

Hydraulic Air Compression. Particulars, with illustrations, in regard to the hydraulic air compressor at Ragged Chutes, Canada. 2200 w. Mines & Min—Oct., 1910. No. 17611 C.

Belt Driving.

The Mechanical Transmission of Power. J. B. M. Knutsen. First of a series of four papers, including devices for transmitting power by means of frictional contact between two comparatively smooth surfaces. Driving belts, ropes, bands of steel, flat-faced friction gears, grooved friction gears, etc. Ills. 1500 w. Aust Min Stand—Sept. 21, 1910. Serial. 1st part. No. 18144 B.

Electric Driving.

Electric Driving in Textile Mills. L. Crouch. A study of the requirements and results obtainable, showing that several slight alterations in the design of textile machines are advisable to secure the full advantages of electrical operation. 2000 w. Elec Rev, Lond—Sept. 23, 1910. Serial. 1st part. No. 17675 A.

Lubrication.

Notes on Economical Lubrication. Notes from an address by William M. Davis, before the Nat. Assn. of Cotton Mfrs. Discusses the selection of proper lubricants, their cost and use. 2500 w. Eng Rec—Oct. 1, 1910. No. 17589.

Power Plants.

Large Southern Cotton Mill Plant. Warren O. Rogers. Illustrated description of the mechanical equipment of a plant supplying power for two 75,000 spindle mills. 1500 w. Power—Oct. 18, 1910. No. 17921.

STEAM ENGINEERING.

Boiler Draft.

Effect of Forced Draft on Boiler Capacity and Economy. A discussion, by C. E. Roehl, of the influence of forced draft, forming a part of a committee report presented to the Am. St. & Int. Ry. Engng. Assn. on Oct. 11. 2000 w. Eng Rec—Oct. 22, 1910. No. 18113.

Boiler Evaporation.

Evaporation in Steam Boilers. John Green. Discusses the efficiency of the furnace and boiler and the effect upon the evaporative power. 3000 w. Boiler Maker—Oct., 1910. No. 17751.

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Boiler Firing.

An Improved Liquid-Fuel Firing System. Describes a system invented by T. A. & W. E. Savery, of Birmingham, Eng., designed to provide for more efficient use of liquid fuel in steam boilers. Ills. 1200 w. Prac Engr—Sept. 23, 1910. No. 17664 A.

Boiler Fittings.

Development of the Blowoff Valve. Charles J. Simeon. Illustrated description of leading blowoff valves of gate and Y types. 1000 w. Power—Oct. 25, 1910. No. 18136.

Boiler Management.

Externally-Fired Boilers at Ironworks in Collieries. Remarks on the management of such boilers and their dangers. 1600 w. Col Guard—Oct. 7, 1910. No. 17906 A.

Boilers.

The Largest Boilers in Existence. Describes a large Sterling boiler installed at the Delray station of the Detroit Edison Co. Ills. 500 w. Power—Oct. 11, 1910. No. 17794.

Boiler Testing.

Standardization of the Boiler Room. William A. Russell. Gives a method of making standardization tests of the performance of a boiler whereby coal can be bought on a B. t. u. basis to suit any market prices. 2500 w. Power—Oct. 18, 1910. No. 17922.

Boiler Tests.

Evaporative Tests of a Nicolson Boiler. Michael Longridge. From the Chief Engr's report for 1909, of the British Engine, Boiler, and Elec. Ins. Co., Ltd. Sectional view with report of tests. 6000 w. Mech Engr—Oct. 14, 1910. No. 18162 A.

Engine Condensation.

The Entropy Diagram in the Study of Condensation (El Diagrama entropico en el Estudio de la Condensacion). A mathematical demonstration of its application to condensation problems. Ills. 2000 w. Energia Elec—Sept. 25, 1910. No. 18031 D.

Engine Economy.

The Influence of Superheating and Vacuum on Steam Consumption (Der Einfluss der Ueberhitzung und des Vakuums auf den Dampfverbrauch). Jar. Hybl. A summary of conclusions drawn from the results of recent extended experiments. Ills. 1500 w. Zeitschr d Ver Deutscher Ing—Sept. 10, 1910. No. 18099 D.

Engine Governor.

Safety Stops for Steam Engines. W. H. Wakeman. Illustrates and describes most of the safety devices used in connection with the engine governor, explaining their action. 3500 w. Power—Oct. 18, 1910. No. 17924.

Engine Lubrication.

Cylinder Lubrication in Large Engines (Le Graissage des Cylindres et des Machines à grande Puissance). Clément Berger. Discusses the increasing importance of the problem of cylinder lubrication with increasing size of engines. 2500 w. Rev Indus—Sept. 10, 1910. No. 18014 D.

Engine Pistons.

Leakage Through a Piston Valve. George Mitchell. Illustrates and describes methods of testing piston valves of small steam engines for leakage. 4500 w. Power—Oct. 11, 1910. No. 17791.

Engine Reconstruction.

Tripling an Old Beam Engine. Explains conditions at the Bromford Ironworks, and the reasons for tripling the beam engine, describing the work. Ills. 1200 w. Engr, Lond—Oct. 14, 1910. No. 18169 A.

Engines.

The Predecessors of Watt's Engine. H. W. Dickinson. Gives salient points in the history of the atmospheric engine of Thomas Newcomen, which preceded Watt's steam engine. Ills. 1700 w. Power—Oct. 4, 1910. No. 17648.

The Evolution of the Steam Engine (Evolution pratique de la Machine à Vapeur). M. A. Mallet. A history of the steam engine from its origin to the present day, with special reference to the development of compounding. Ills. Serial. 1st part. 28000 w. Mem Soc Ing Civ de France—Aug., 1910. No. 18016 G.

European Lift-Valve Engines. Warren H. Miller. An illustrated review of advanced practice. 2500 w. Engineering Magazine—Nov., 1910. No. 18254 B.

The Walschaerts-Recke Steam Engine (La Machine à Vapeur Walschaerts-Recke). Describes a novel engine exhibited at Brussels. Ills. 2000 w. Rev Indus—Sept. 3, 1910. No. 18012 D.

Engine Stresses.

Inertia Stresses in Reciprocating Engines with Oscillating Cylinders (Le Forze d'Inerzia nelle Macchine a Stantuffo col Cilindro mobile). A. Anastasi. A mathematical study of the stresses due to inertia in engines of this type. Ills. 3000 w. Ann d Soc d Ing e d Arch Ital—Aug. 15, 1910. No. 18024 F.

Engine Tests.

Trials of a Horizontal Compound Tandem Engine. Michael Longridge. Extract from the annual report for 1909 of the British Engine, Boiler, & Elec. Ins. Co., Ltd. Gives results of the trials with explanatory comment. 1000 w. Mech Engr—Sept. 23, 1910. No. 17669 A.

Exhaust Steam.

The Utilization of Exhaust Steam from High-Pressure Engines (Die Verwendung von Abdampf aus Hochdruckmaschinen). Herr Recke. A discussion of the economy of exhaust-steam heating. Ills. 3500 w. Zeitschr d Ver Deutscher Ing—Sept. 24, 1910. No. 18205 D.

See also Turbines, under STEAM ENGINEERING.

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Fuel Purchasing.

See Boiler Testing, under STEAM ENGINEERING.

Fuels.

Practical Fuel Values. W. P. Young. Considers qualities that add to or subtract from the value of coal for special uses. 2000 w. Mines & Min—Oct., 1910. No. 17620 C.

Loss in Coal Due to Excess Air. H. J. Westover. Gives simple method of determining the proper amount of air for complete combustion. 2000 w. Power—Oct. 11, 1910. No. 17792.

Stacks.

Natural Draft and Chimney Design. H. G. Brinkerhoff. Abstract of paper read before the Nat. Assn. of Cotton Mfrs. Considers the factors affecting the dimensions of chimneys. 1400 w. Power—Oct. 4, 1910. No. 17651.

Superheating.

The Improvement of Steam Plant Efficiency. Carl C. Thomas. An outline of the history and early development of superheating, with a review of some of the difficulties encountered in its application. 5500 w. Wis Engr—Oct., 1910. No. 17940 C.

See also Engine Economy, under STEAM ENGINEERING.

Turbine Design.

Blade Proportioning in Reaction Type Steam Turbine. Ernest R. Briggs. A study of design. 1200 w. Engr, Lond—Sept. 23, 1910. Serial. 1st part. No. 17682 A.

The Calculation of Steam-Turbine Bases and Drums (Beitrag zur Berechnung von Dampfturbinen-Zwischenböden und Trommelscheiben). C. Neugebohrn. Mathematical. Ills. Serial. 1st part. 4000 w. Zeitschr f d Gesamte Turbinenwesen—Sept. 10, 1910. No. 18057 D.

Turbine Governing.

A Dynamic Study of a Turbine Governor (Etude dynamique avec Essais de Contrôle d'un Appareil de Réglage pour Turbines). Alfred Barbezat. A mathematical discussion with report of tests. Ills. 4000 w. Schweiz Bau—Sept. 3, 1910. No. 18055 B.

Turbines.

Bergmann Steam Turbines. Illustrated description of a turbine of the pure action type, giving a summary of advantages claimed. 2000 w. Prac Engr—Oct. 14, 1910. No. 18159 A.

Horizontal Steam Turbines of Moderate Output. Frank C. Perkins. Illustrates and describes turbines of various types that have been utilized to advantage. 1200 w. Min Wld—Oct. 1, 1910. No. 17623.

Valves.

The Zeuner Valve Diagram. W. J. Harden. An explanation of this diagram, which offers a simple means of studying the relative positions of the valve and main crank during one revolution of the engine. 1300 w. Power—Oct. 11, 1910. No. 17790.

Water Hammer.

Water-Hammer Action in Steam Boilers. Discusses the conditions for the development of water-hammer action, the nature of the disturbance, precautions for its avoidance, etc. 5000 w. Locomotive—July 25, 1910. No. 17784.

TRANSPORTING AND CONVEYING.

Cableways.

Utah Consolidated Aerial Tramway. Leroy A. Palmer. Illustrates and describes a method of transporting economically a large tonnage of ore in a rough region. 2000 w. Mines & Min—Oct., 1910. No. 17615 C.

Conveyors.

Conveyors. Henry J. Edsall. Illustrates and describes appliances for transporting materials and merchandise. 5000 w. Cassier's Mag—Oct., 1910. No. 17697 B.

Cranes.

The Various Types of Gantry Cranes (Die verschiedenen Arten der Verlade-Bockkrane—Verladebrücken). F. Wintermeyer. A review of the various types of travelling gantries adapted to the unloading of ships and similar purposes. Ills. Serial. 1st part. 2000 w. Elektrotech Rundschau—Sept. 29, 1910. No. 18078 D.

MISCELLANY.

Aeronautics.

The Atmospheric Ocean. Prof. A. Lawrence Rotch. Considers some general characteristics of the atmosphere, and illustrates and describes the methods of investigation as carried out at Blue Hill, near Boston. 2000 w. Sci Am—Oct. 22, 1910. No. 18109.

The Practice and Theory of Aviation. Grover Cleveland Loening. Illustrates and describes in detail the fourteen most prominent types of aeroplanes, including seven biplanes and seven monoplanes. 3000 w. Sci Am Sup—Oct. 22, 1910. No. 18111.

Flight at High Altitudes. Marius C. Krarup. Translation and review of an article by Henry Petit considering effects of altitude on motor and aeroplane functions. 2500 w. Automobile—Oct. 6, 1910. No. 17736.

Historical—The Development of the Man-Carrying, Motor-Driven Aeroplane. An illustrated review from the Lilienthal glider of 1895 to the Wright biplane of 1903. 2500 w. Sci Am—Oct. 22, 1910. No. 18104.

The Structural Design of Aeroplanes. Herbert Chatley. A discussion of the general form of the frame and the stresses. General discussion follows.

7500 w. Trans Inst of Civ Engrs of Ireland—Vol. XXXVI. 1910. No. 18219 N.

The Racing Aeroplane of the Future—A Study. J. Bernard Walker. A prediction of the leading characteristics based on a study of the trend of development. 1600 w. Sci Am—Oct. 22, 1910. No. 18106.

Leading French and American Aeroplanes, Their Construction and Methods of Control. Illustrated description of leading types and their methods of operation. 1500 w. Sci Am—Oct. 22, 1910. No. 18105.

The Regnard Aeroplane. Paul F. Mottelay. Illustrates and describes apparatus for securing the automatic stability of flying machines by means of the gyroscope. 1200 w. Sci Am Sup—Oct. 8, 1910. No. 17725.

Tests of Aeroplane Propellers. R. E. Dudley and Arthur Steed. A thesis presented at Univ. of Missouri. A report of laboratory tests on air propellers at various pitches at various speeds. 2000 w. Am Mach—Vol. 33. No. 43. No. 18187.

Aerial Propellers and Some Test Results. Charles Edward Larard and Robert Oliphant Boswall. Slightly abridged from *Engineering*. An illustrated report of experimental work and results. 2500 w. Jour Fr Inst—Oct., 1910. No. 17937 D.

Air Craft in War. An illustrated discussion of the possibilities of aeroplanes and dirigibles. 1500 w. Sci Am—Oct. 22, 1910. No. 18107.

The Aeroplane in War. Describes practical tests made of the military airship and aeroplane at the French military manoeuvers of 1910. 3500 w. Sci Am Sup—Oct. 15, 1910. No. 17845.

Learning to Fly on French Aerodromes. W. F. Bradley. An illustrated account of present methods of instruction. 1500 w. Sci Am—Oct. 22, 1910. No. 18108.

The First Crossing of the Alps in an Aeroplane. An illustrated account of the crossing by George Chaviz, made on Sept. 23, 1910. 2000 w. Sci Am Sup—Oct. 22, 1910. No. 18110.

Story of the Wellman Ocean Air Trip. Illustrated account of the trip, by Mr. Vaniman. 1800 w. Sci Am—Oct. 29, 1910. No. 18235.

"Clement-Bayard II." Carl Dienstbach. Illustrated description of the French military dirigible airship which took part in the French manoeuvers. 1500 w. Sci Am—Oct. 8, 1910. No. 17723.

The Dirigible "Clement-Bayard II" (Le Dirigeable "Clément-Bayard II"). A. Riester-Picard. Describes the winner in the French War Office trials. Ills. 1800 w. Génie Civil—Sept. 17, 1910. No. 18019 D.

See also Units, under MEASUREMENT.

Curtain Rollers.

Gravity Self-Raising Rollers for Maps, Theatre Curtains, Etc. R. W. Weekes. Read before the Engng. Sec. of the British Assn., at Sheffield. A detailed description of a gravity system of suspending, explaining its advantages. 800 w. Engng—Oct. 14, 1910. No. 18166 A.

Textile Machinery.

Textile Machinery at the Brussels Exposition (Die Arbeitsmaschinen für die Textilindustrie auf der Weltausstellung in Brüssel 1910). G. Rohn. Detailed description of the exhibits. Ills. Serial. 1st part. 5000 w. Zeitschr d Ver Deutscher Ing—Sept. 10, 1910. No. 18097 D.

Watch Jewels.

Manufacturing Jewels for Watches. F. A. Stanley. Illustrates and describes how the stones are held, lapped down, chipped, turned, drilled and finished at a remarkable rate of speed. 2500 w. Am Mach—Vol. 33. No. 41. No. 17878.

Weighing Machines.

Weighing Materials Automatically. Illustrated descriptions of accurate mechanical devices for this work. 3500 w. Am Mach—Vol. 33. No. 40. No. 17708.

MINING AND METALLURGY.

COAL AND COKE.

Anthracite.

Anthracite. Considers true anthracite, "ash content" of anthracite, metamorphic anthracite, and the heat theory of formation. 1800 w. Col Guard—Oct. 7, 1910. No. 17908 A.

Coke Ovens.

Koppers By-Product Coke Ovens. W. F. Hartman. Illustrated description of a process by which ammonium sulphate is made directly from the gas. 2400 w. Mines & Min—Oct., 1910. No. 17621 C.

Coking.

Mining, Preparing, and Coking Coal. Illustrates and describes the plant and methods used at Marting, W. Va. 3000 w. Mines & Min—Oct., 1910. No. 17618 C.

Conservation.

Conservation as it Affects Coal Lands. E. W. Parker. Read before the Am. Min. Cong.. Discusses conditions and methods responsible for waste. 2000 w. Min & Sci Pr—Oct. 8, 1910. No. 17848.

Electric Power.

Electric Shocks in Coal Mines. Sydney F. Walker. A review of actual and

unusual cases where fatal results have followed careless handling of charged apparatus. 7000 w. Eng & Min Jour—Oct. 8, 1910. No. 17782.

Explosions.

Protective Value of Humidity. James Ashworth. Discusses whether moisture has any protective value on the progress of explosions, deciding in the negative. 2500 w. Mines & Min—Oct., 1910. No. 17622 C.

Some Causes and Prevention of Colliery Explosions. George H. Winstanley. A lecture before the Nat. Assn. of Colliery Mgrs. Explains the term explosion, and discusses the dangers causing such disasters in coal mines. 7000 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17820 A.

Germany.

Coal Mines Operated by Ironworks in the Ruhr District, Germany (Die Hüttenzechenfrage im Ruhrbezirk). Herr Pilz. Discusses in great detail their effect on the German coke industry. Serial. 1st part. 18000 w. Glückauf—Sept. 17, 1910. No. 18048 D.

Indiana.

Mining Coal in Southern Indiana. Floyd W. Parsons. Information concerning methods employed, cost of mining, and explosives. Ills. 1000 w. Eng & Min Jour—Oct. 29, 1910. No. 18242.

Mine Dust.

The Explosibility of Coal Dust. George S. Rice. With chapters by J. C. W. Frazer, Oxel Larsen, Frank Haas, and Carl Scholz. States the problem and gives a review of the question in Europe and the United States, reporting experimental studies, and related matters of interest. Ills. 6500 w. U. S. Geol Surv—Bul. 425. No. 17985 N.

Mining.

Division of Labor in Bituminous Coal Mining. W. E. Fohl. A plan for eliminating the factors of inefficiency in the processes of coal production. 2500 w. Engineering Magazine—Nov., 1910. No. 18252 B.

Mining Plants.

A Mining Power Plant. Illustrated description of the Hampton Electric power plant of the D., L. & W. Ry. Co. at Scranton, Pa. 2000 w. Elec Rev, N Y—Oct. 1, 1910. No. 17600.

Montana.

Stratigraphic Relations of the Livingston Formation of Montana. R. W. Stone and W. R. Calvert. Gives results of field study, showing the coal-bearing formation of the Livingston section is not Laramie, and giving information of geologic interest. Map. 2200 w. Ec-Geol—Sept., 1910. No. 17934 D.

Peat.

The Production of Peat. L. B. Lincoln. Illustrates and describes a new automatic movable peat plant based on the wet machine process. 1200 w. Heat & Vent Mag—Oct., 1910. No. 18130.

Rescue Apparatus.

A Comparison of the Earlier Dräger Apparatus with the 1910 Model (Vergleich der ältern Dräger-Apparate mit dem neuen Modell 1910). Fritz Jüngst. A comparison of the structure and efficiency of the apparatus. Ills. 4500 w. Glückauf—Sept. 10, 1910. No. 18046 D.

Rescue Stations.

The Progress of Rescue Stations in British Coal Mines. T. Lington. Information concerning what is being done toward establishing such stations at collieries. 1500 w. Min Wld—Oct. 1, 1910. No. 17626.

Notes on Rescue Training. Read before the Nat. Assn. of Col. Mgrs. Part of a paper by T. T. Mawson. Describes the principal features of the Howe Bridge station and the training of the rescue brigade. 4500 w. Ir & Coal Trds Rev—Sept. 23, 1910. No. 17685 A.

Safety Lamps.

New Acetylene Safety Lamps. Bergassessor Beyling, in *Glückauf*. Illustrates and describes the Wolf, the Seippel, and the Koch designs. 1500 w. Ir & Coal Trds Rev—Sept. 23, 1910. No. 17684 A.

Wales.

The Submarine Area of Coal Measures in Swansea Bay. Henry K. Jordan. From a paper read before the S. Wales Inst. of Engrs. Map showing conjectured area, with remarks on the probable extent and thickness of the coal measures. 2000 w. Ir & Coal Trds Rev—Oct. 14, 1910. No. 18175 A.

Washing.

The Sizing, Sorting and Washing of Coal. W. Bardill. Deals with the processes in use at the present time and the departures likely to appear in the near future. 6000 w. Ir & Coal Trds Rev—Oct. 7, 1910. No. 17916 A.

COPPER.

Arizona.

See Prospecting, under MINING.

Assaying.

Analytical Methods in the Cananea Laboratory. F. G. Hawley. Explains the methods of routine chemical analysis used. 5500 w. Eng & Min Jour—Oct. 1, 1910. No. 17602.

The Color and Cyanide Methods for Copper. Arthur Austin. Abstract from *Western Chemist and Metallurgist*, of a paper giving résumé of practice at a large western smeltery, with abstracts from articles relative to the colorimetric and cyanide copper determinations. 4000 w. Min Wld—Oct. 22, 1910. No. 18125.

Chile.

The Collahuasi Copper District, Chile. Robert Hawxhurst. Map, history and general description of the district, its ge-

ology, ore deposits, and mining properties. 3500 w. Min Mag—Oct., 1910. No. 18212 B.

Mexico.

A Geological Journey in Guerrero. John Wellington Finch. A geological discussion of the district, especially considering the Reforma Mine, Campo Morado, Mexico. Ills. 3500 w. Min & Sci Pr—Oct. 15, 1910. No. 17996.

Peru.

Mining in Quiruvilca, Province of Santiago de Chuco, Peru. F. Malaga Santolalla. Information concerning the geology and mineral deposits, and the Elvira mine. 1200 w. Min Jour—Oct. 1, 1910. No. 17827 A.

Refining.

Electrolytic Copper Refining in Australia. G. H. Blakemore. Abstract of paper before the Australian Inst. of Min. Engrs. Describes plant and methods in use at Lithgow, N. S. W. Ills. 4000 w. Eng & Min Jour—Oct. 8, 1910. Serial. 1st part. No. 17781.

Smelting.

Mining and Smelting in Aguascalientes. Bruno Newman. Brief description, with illustration, of the largest custom smelter in America. 1500 w. Eng & Min Jour—Oct. 1, 1910. No. 17610.

GOLD AND SILVER.

Assaying.

Assay of Arsenical Nickel Cobalt Silver Ore. Denison K. Bullens. Information concerning the sampling and assaying of Cobalt silver ore. 2000 w. Eng & Min Jour—Oct. 22, 1910. No. 18101.

Brazil.

Notes on Passagem Mine and Works. Arthur J. Bensusan. Describes the geological and mineralogical features of this gold mine in Minas Geraes, Brazil, method of mining, etc. 8800 w. Inst of Min & Met, Bul. 73—Oct. 15, 1910.

British Columbia.

The Bayonne Mining District, British Columbia. Map, showing location, with descriptive notes. 1600 w. Min Wld—Oct. 1, 1910. No. 17627.

Cobalt

The Structure of Silver Deposits of Nipissing. Reginald E. Hore. Detailed description of the ore deposits, the influence of country rock, the geology of the district, etc. Ills. 2500 w. Min Wld—Oct. 22, 1910. No. 18124.

The Timmins - Armstrong - McGibbons Areas. Alex. Gray. An illustrated account giving information of these properties in Canada. 4500 w. Min Wld—Oct. 8, 1910. No. 17797.

Costa Rica.

Mines and Mill of Montezuma Mines, Costa Rica. S. F. Shaw. Illustrated description of veins and their development. 2200 w. Eng & Min Jour—Oct. 8, 1910. No. 17780.

Cyaniding.

Present Tendencies in Cyanide Practice. Mark R. Lamb. Reviews record developments at different plants. 5000 w. Eng & Min Jour—Oct. 29, 1910. No. 18240.

Modern Hydrometallurgy in Australia. J. R. Masson and J. E. Edwards. An illustrated account of methods of treatment of gold and silver-bearing ores. 2500 w. Met & Chem Engng—Oct., 1910. No. 17763 C.

The New Clancy Method of Ore Treatment. Relates to novel methods of treating ores bearing the precious metals. 5000 w. Min Wld—Oct. 15, 1910. No. 17884.

Dredging.

Notes on the Construction of California Dredges. John Tyssowski. A report of the tendency in building, and the cost, giving tabulated data on the dredge equipment and power consumption. Plate. 3500 w. Eng & Min Jour—Oct. 15, 1910. No. 17872.

Dredging Conditions on the Seward Peninsula. G. B. Massey, II. Illustrates and describes dredges and their operation in a region noted for the general distribution of gold. 6500 w. Eng & Min Jour—Oct. 29, 1910. No. 18241.

Mexico.

Mineral Resources of the State of Guerrero. William Niven. Illustrated account of important gold-producing properties. 2000 w. Eng & Min Jour—Oct. 1, 1910. No. 17609.

The Arteaga District, Chihuahua. L. T. Pockman. Brief illustrated description. The principal mineral is argentite. 700 w. Eng & Min Jour—Oct. 1, 1910. No. 17605.

Mining Operations in the State of Chihuahua. W. H. Seamon. The mines produce silver, gold, lead, copper, and zinc. There are also large deposits of iron ore. Reports conditions at the various properties being worked. 2500 w. Eng & Min Jour—Oct. 1, 1910. No. 17604.

Yoquivo Mine and Mill, Western Chihuahua. W. H. Seamon. Gives results of two years' development of this silver-gold property. Ills. 1200 w. Eng & Min Jour—Oct. 22, 1910. No. 18102.

San Rafael of Anexas Mining Company, Pachuca. E. Girault. Abstract translation describing the properties and their development. Averages 1,080 grams silver and 4 grams gold to the ton. Profile and section. 3000 w. Eng & Min Jour—Oct. 1, 1910. No. 17601.

See also Placers, under GOLD AND SILVER.

Montana.

History and Geology of the Garnet District, Mont. J. P. Rowe. Illustrates and describes the district and its gold-mining properties, reviewing the early mining

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history. 5000 w. Min Wld—Oct. 15, 1910. No. 17883.

Nevada.

The Cost of Goldfield Mining Boom. Augustus Locke. Considers especially the more important losses resulting from the boom of this Nevada district, and also some important gains. Ills. 2000 w. Min & Sci Pr—Oct. 22, 1910. No. 18226.

Notes on Operations in Jarbidge Camp, Nevada. Winthrop W. Fisk. Describes deposits of low-grade gold ores, reporting promising showings. Map. 2000 w. Eng & Min Jour—Oct. 15, 1910. No. 17871.

Ontario.

The Porcupine Trail. Reginald E. Hore. An illustrated account of Ontario's newest gold camp. 1500 w. Can Min Jour—Oct. 15, 1910. No. 17960.

The First Rush to the Porcupine Gold Fields. Alex. Gray. Illustrated account of early discoveries and development in this Canadian field. 4000 w. Min Wld—Oct. 1, 1910. No. 17624.

Present Developments at Gowganda. G. M. Colvocoresses. Explains conditions at this silver camp and gives illustrated detailed descriptions of some of the mines. 3000 w. Can Min Jour—Oct. 1, 1910. No. 17703.

The Quartz Diabases of Nipissing District, Ontario. W. H. Collins. Discusses the petrology of these bodies, and attempt to determine their relations to the silver-cobalt ore deposits. 4200 w. Ec-Geol—Sept., 1910. No. 17933 D.

Placers.

The Altar Gold Placer Fields of Sonora, Mexico. Illustrates and describes the country and mining methods employed. 2500 w. Eng & Min Jour—Oct. 1, 1910. No. 17603.

Silver.

The Solubility of Oxygen in Molten Silver. F. G. Donnan and T. W. A. Shaw. Abstract of paper read before the Soc. of Chem. Ind. Describes investigations. 2500 w. Min Wld—Oct. 8, 1910. No. 17798.

IRON AND STEEL.

Blast-Furnace Gas.

The Purification of Blast Furnace Gas in Germany. Curt Grosse. From a paper before the Dusseldorf Congress. Illustrates and describes appliances in use. 2500 w. Ir & Coal Trds Rev—Oct. 14, 1910. No. 18176 A.

Blowers.

New Turbo-Blower Driven by Exhaust Steam at the Works of Altos Hornos de Vizcaya. Illustrated description of a Rateau mixed-pressure turbo-blowing plant, with accumulator and Le Blanc condenser. 1400 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17819 A.

Electrometallurgy.

Recent Advances in the Construction of Electric Furnaces for the Production of Pig Iron, Steel, and Zinc. Eugene Haanel. Introductory remarks on the present status of the electric steel industry, with list of electric steel furnaces in Europe, etc.; information concerning iron and smelting furnaces, and for the reduction of steel and zinc oxide, and other related subjects. Ills. 20000 w. Can Dept of Mines—No. 68. No. 17980 N.

See also Ferro-Alloys, Steel Refining, and Steel Works, under IRON AND STEEL; and Refractory Materials, under MISCELLANY.

Expositions

Iron and Steel at the Brussels Exposition (Das Eisenhüttenwesen auf der Brüsseler Weltausstellung 1910). Reviews the exhibits by countries. Ills. 7000 w. Stahl u Eisen—Sept. 21, 1910. No. 18039 D.

Ferro-Alloys.

Electrometallurgy of Ferro-Alloys and Steel. Paul Girod. Abstract of paper read before the Faraday Soc. A short description of the principal alloys made by the use of the Girod furnace. 1200 w. Elect'n, Lond—Oct. 14, 1910. No. 18155 A.

Industry.

Co-operation in the Iron and Steel Industry; Presidential Address Before the American Iron and Steel Institute. Elbert H. Gary. An important address, advocating co-operation. Also editorial. 4000 w. Eng News—Oct. 20, 1910. No. 17957.

Mexico.

Iron Resources of the Republic of Mexico. Ezequiel Ordonez. A report of deposits and their character. 2500 w. Eng & Min Jour—Oct. 1, 1910. No. 17608.

Minnesota.

Minnesota's Great Iron Mining Industry. W. W. J. Croze. Paper prepared for the Conservation Congress at St. Paul. Map, illustrations and information concerning the producing ranges, transportation, etc. 2500 w. Min Wld—Oct. 15, 1910. No. 17885.

Ontario.

The Occurrence and Origin of Some Bog Iron Deposits in the District of Thunder Bay, Ontario. Elwood J. Moore. A discussion of the factors bearing upon the nature of the occurrence and origin of the iron. 3300 w. Ec-Geol—Sept., 1910. No. 17932 D.

Rolling Mills.

Power Required for Rolling Steel. J. A. Knesche. Second of two articles giving tabulation, analysis, and discussion of test data. 6000 w. Engineering Magazine—Nov., 1910. No. 18257 B.

Further Researches on the Power Requirements of Rolling Mills (Weitere Versuche zur Ermittelung des Kraftbedarfes an Walzwerken). An abstract of J. Puppe's report of the work of the Commission appointed by the Verein Deutscher Eisenhüttenleute. Ills. 3000 w. Stahl u Eisen—Sept. 21, 1910. No. 18038 D.

We supply copies of these articles. See page 487.

The Utilization of Electric Power in the Iron and Steel Industry; With Special Reference to the Economical Speed Regulation of the Motors. J. J. Elink Schuurman. Read before the Iron & Steel Inst. Discusses economical speed regulation, describing the Scherbius, the Krämer, and the Déri systems and their applications. Ills. 6000 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17816 A.

The Manufacture of Rolled "H"-Beams. George E. Moore. Read before the Iron & Steel Inst. Illustrates and describes a few characteristic types of machines, with critical remarks and suggestions. 5500 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17815 A.

The Inland Steel Company's Works. Illustrated detailed description of the Indiana Harbor Sheet Mills. 3500 w. Ir Age—Oct. 20, 1910. No. 17994.

Steel Refining.

Electric Steel Refining. D. F. Campbell. Read before the Iron & Steel Inst. Discusses the general aspects of the subject and the probable and possible developments in England. 3000 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17808 A.

Steel Works.

The Passing of Crucible Steel. Joseph W. Richards. Illustrates and describes the general plan of the works at Remscheid-Hasten, in Germany, giving a detailed description of the electric furnace work. 3000 w. Met & Chem Engng—Oct., 1910. No. 17758 C.

The Hanyang Iron and Steel Works. George Chamier. Read before the Iron & Steel Inst. Brief illustrated description of these works in China, and the circumstances that have contributed to their marked success. 1200 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17809 A.

LEAD AND ZINC.

Lead Smelting.

See Smelting, under COPPER.

Mexico.

Mining and Smelting at Achotta Mine, Guerrero. W. B. Devereux, Jr. Illustrated description of this mining and smelting plant. Only oxidized silver lead ores are smelted at present. 1200 w. Eng & Min Jour—Oct. 1, 1910. No. 17607.

Missouri.

Economic Conditions in the Joplin District. T. Lane Carter. An illustrated article giving a favorable report. 2200 w. Eng & Min Jour—Oct. 15, 1910. No. 17870.

Zinc Smelting.

See Electrometallurgy, under IRON AND STEEL.

MINOR MINERALS.

Aluminium.

The Manufacture of Aluminium Powder (Fabrication de la Poudre d'Aluminium). M. Delastre. Reviews past and present practice in France, referring particularly to the dangers and their prevention. Ills. 2500 w. Rev d'Econ Indus—Sept., 1910. No. 18001 D.

Diamonds.

Blast-Furnace Diamonds and the Diamond Problem (Hochofendiamanten und das Diamantenproblem). Hans Fleissner. A discussion of the problem of making diamonds artificially. Ills. Serial. 1st part. 2000 w. Oest Zeitschr f d Berg u Hüttenwesen—Sept. 17, 1910. No. 18045 D.

Marble.

Australian Marble Industry. Description of rich deposits in Victoria. 3000 w. Aust Min Stand—Sept. 14, 1910. No. 18141 B.

Natural Gas.

The Kent Gas Field. G. R. Mickle. Describes this oil field of Ontario and gives information relating to it. 2500 w. Can Min Jour—Oct. 15, 1910. No. 17961.

Oil.

A Proposed Classification of Petroleum and Natural Gas Fields Based on Structure. Frederick G. Clapp. A brief account of the "anti-clinal theory," its history and application, considering its limitations, and a statement of the structural theory, with a classification showing that accumulations can be grouped into classes. Ills. 4500 w. Ec-Geol—Sept., 1910. No. 17931 D.

Oil in Mexico. Sydney A. R. Skertchly. Remarks on local conditions that govern the oil business in Mexico. Map and Ills. 2200 w. Min Mag—Oct., 1910. No. 18213 B.

Radioactive Minerals.

A New Radio-Active Mineral in Western Australia. E. S. Simpson. Read before the Nat. Hist. & Sci. Soc. of W. Australia. Information concerning "Pilbarite," a new mineral from the Pilbarra goldfields. 2000 w. Aust Min Stand—Sept. 7, 1910. No. 17888 B.

Radium.

Notes on Radium Research. J. H. Niemann. Considers reasons for considering radium the cause of the amethyst coloration of crystal glass. 1000 w. Aust Min Stand—Sept. 21, 1910. No. 18142 B.

Tin.

See Prospecting, under MINING.

Tungsten.

Moose River Tungsten Deposits, Nova Scotia. E. R. Faribault. Abstract of a paper read before the Min. Soc. of Nova Scotia. Describes the deposits and states conclusions from their study. 2000 w. Min Wld—Oct. 8, 1910. No. 17796.

MINING.

Accidents.

Mine Accidents and the Bureau of Mines. George S. Rice. Read before the Am. Min. Cong. Information concerning the high accident rate and the work of the Bureau of Mines. 2500 w. Min & Sci Pr—Oct. 8, 1910. No. 17849.

See also Law, under MINING.

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Drainage.

Peculiar Water Problem at Candelaria Mines. George A. Laird. Explains the conditions which make necessary the draining of saturated bodies of soft ore surrounded by country rock. Describes methods used. 2000 w. Eng & Min Jour —Oct. 1, 1910. No. 17606.

Drills.

A Comparative Study of Hydraulic and Compressed-Air Drills (Le Perforatrici idrauliche e ad Aria Compressa). S. Gilardi. Gives data obtained in the driving of the Simplon tunnel. Ills. 6000 w. Ing Ferro—Sept. 1, 1910. No. 18030 D.

Electric Power.

Examination for Certificate of Competency as Mine Electrician in New South Wales. Gives lists of questions set for candidates at the examinations held at the technical colleges. 1500 w. Ir & Coal Trds Rev—Oct. 7, 1910. No. 17919 A.

Electrical Mining Notes. Sidney F. Walker. Considers causes of accidents, believing the troubles due to absence of care or poor insulation, and discusses applications. 4000 w. Elec Rev, N Y—Oct. 8, 1910. No. 17778.

Explosives.

The Proper Detonation of High Explosives. Charles S. Hurter. Abstract of a paper read before the L. Superior Min. Inst. Classifies explosives, and discusses in detail the subject of detonation. 5500 w. Min Wld—Oct. 22, 1910. No. 18127.

Haulage.

Electric Haulage in Colleries and Mines. Illustrates and describes types of rope haulage gears driven by electric motors. 3000 w. Elec Rev, Lond—Sept. 30, 1910. No. 17821 A.

Electric Haulage in Mines. Arthur Hall. Read at Nat. Assn. of Col. Mgrs. Especially discusses the efficiency, economy and speed. Ills. 4500 w. Ir & Coal Trds Rev—Oct. 7, 1910. No. 17920 A.

Transport of Coal and Ore by Electric Traction. W. C. Brown. Read before the S. African Inst. of Elec. Engrs. Discusses types of motors, weight of rails, and other matters affecting the success. 4500 w. Elec Engr, Lond—Sept. 23, 1910. No. 17673 A.

Underground Haulage in German Mines. F. Tillmann. Abstract translation of paper read at the Dusseldorf Cong. Describes various systems of haulage in German mines, giving particulars of the relative cost. 2000 w. Ir & Coal Trds Rev—Oct. 7, 1910. No. 17915 A.

Hoisting.

The Evolution of Hoisting. Describes ancient methods showing the ideas from which modern machines have been derived. Ills. 4200 w. Mines & Min—Oct., 1910. Serial. 1st part. No. 17616 C.

The Safety of Hoisting Ropes (Seilsicherheit bei der Schachtförderung). F. Baumann. Discusses the method of calculating the size of rope to be used for a given service. 4000 w. Glückauf—Sept. 24, 1910. No. 18050 D.

Hoisting Engines.

Experiments with Steam and Electric Winding Engines. Trans. from *Glückauf*. Gives tabulated information based on experiments on the consumption of power in winding engines, with a view to establishing comparative data for the various structural types of engine. 1000 w. Col Guard—Sept. 30, 1910. No. 17830 A.

Labor.

The Efficiency of Labor Underground. Tom Johnson. Outlines a scheme for increasing the efficiency of the men. 2500 w. Jour Chem, Met. & Min Soc of S Africa—Aug., 1910. No. 17886 E.

Law.

Report of Committee on Uniform Mining Laws for Prevention of Mine Accidents. 14000 w. Bul Am Inst of Min Engrs—Oct., 1910. No. 18132 F.

Mine Buildings.

Fireproof Buildings for Mining Companies. Ernest McCullough. Describes the construction of a new character of building which costs little more than wood-frame structures, and has many advantages. Ills. 2000 w. Min Wld—Oct. 8, 1910. No. 17795.

Mine Development.

Notes for the Mining Public Concerning Certain Mistaken Ideas. F. Danvers Power. Read before the Aust. Inst. of Min. Engrs. A general discussion of mine development and matters related. 6500 w. Queens Gov Min Jour—Sept. 15, 1910. No. 18140 B.

Prospecting.

Prospecting for Tin in Siam. G. B. Adeney. Describes the indications which lead the prospector, the methods employed in proving the value of the ground, and the results. Map. 1500 w. Min Mag—Oct., 1910. No. 18214 B.

Prospecting with Churn Drills at Miami, Ariz. H. A. Fuld. Gives data taken from the drill log of one of the copper companies concerning the drilling, economic conditions, etc. 1200 w. Eng & Min Jour —Oct. 22, 1910. No. 18100.

Pumping.

Pumping at Bisbee, Arizona. C. C. Austin. Illustrates and describes the plant at the Junction shaft of the Superior and Pittsburg Copper Co. 2000 w. Mines & Min—Oct., 1910. No. 17612 C.

Shafts.

Elliptical vs. Rectangular Shafts. William Archie Weldin. Presents some advantages of rectangular over elliptical forms for concrete-lined shafts. Ills. 3000 w. Mines & Min—Oct., 1910. No. 17617 C.

Method and Cost of Lining a Mine Shaft with Concrete. R. H. Worcester. Illustrated detailed description of the

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work, with itemized costs. 4000 w. Engng-Con—Oct. 26, 1910. No. 18188.

Shaft Sinking.

Deep Excavation by Boring. J. F. Springer. Briefly outlines excavation methods used for various depths and conditions, and illustrates and describes the well-boring process of sinking shafts. 1800 w. Sci Am—Oct. 15, 1910. No. 17844.

See also Boring, under CIVIL ENGINEERING, CONSTRUCTION.

Stowing.

The Stowing Plant at Shafts I-VI of the Consolidation Mine (Die Spülversatzeinrichtungen auf der Schachtanlage I-VI der Zeche Consolidation). Herr Schäfer. Detailed description of the method of stowing this German mine. Ills. 4000 w. Glückauf—Sept. 10, 1910. No. 18047 D.

Timbering.

The Timbering Rule. Explains the aspects of the rule that may create doubt as to its real meaning. 700 w. Col Guard—Oct. 7, 1910. No. 17907 A.

Timbering in the Joplin District. Lucius L. Wittich. Describes conditions requiring large quantities of timber, and the method of placing. Ills. 2500 w. Mines & Min—Oct., 1910. No. 17614 C.

Ventilation.

The Coefficient of Friction. William Clifford. Discusses the difficulty of calculating the necessary pressure by estimating the rubbing surface, and contends that each mine has its own particular coefficient. 2500 w. Mines & Min—Oct., 1910. No. 17619 C.

Ventilation and Health Conditions on the Mines of the Witwatersrand, with Special Reference to the Ventilation System of the East Rand Proprietary Mines. S. Penlerick. Considers means to remove the causes of disease among miners, giving illustrated description of a system of forced ventilation. Discussion. 10000 w. Jour Chem, Met, & Min Soc of S Africa—Aug., 1910. No. 17887 E.

ORE-DRESSING AND CONCENTRATION.

Briquetting.

The Briquetting of Iron Ores. Chevalier C. DeSchwarz. Read before the Iron & Steel Inst. States conditions for successful briquetting and considers systems in which a binding medium is used, and systems without a binding medium. 5500 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17817 A.

Agglomerating Ore Fines and Flue Dust. Herbert Haas. Explains causes of the production of flue dust and gives an illustrated description of the Haas process of sintering ore fines. 3500 w. Eng & Min Jour—Oct. 22, 1910. No. 18103.

Electrostatic Separation.

Use of Static Electricity in the Separation of Mineral Particles. Henry A. Wentworth. An illustrated description of an electrostatic separating mill, with information relating to its use. 1800 w. Elec Wld—Oct. 6, 1910. No. 17711.

Gold Milling.

Treatment of Refractory Low-Grade Gold Ores at the Ouro Preto Gold Mine, Brazil. R. H. Kendall. Deals with modifications and improvements effected by the author during his stay at the mine. 10800 w. Inst of Min & Met, Bul. 73—Oct. 15, 1910. No. 18134 N.

Ore-Reduction Plant at City Deep Mines, Ltd. Rowland Gascoyne. Illustrated description of a plant on the Witwatersrand, designed to treat 65000 tons of ore per month, driven by electricity. 1800 w. Min Wld—Oct. 22, 1910. No. 18126.

Iron.

New Plant for Washing Iron Ore, Mesabi Range. E. K. Soper. Plans and description of the Oliver washery at Coleraine, Minn., in which log-washers and Overstrom tables are used. 2000 w. Eng & Min Jour—Oct. 8, 1910. No. 17779.

Zinc Milling.

Zinc Ore Dressing in Colorado. H. C. Parmelee. Describes the property and methods of the Marion Mines and Mill Co., at Fairview, Colo. 2000 w. Met & Chem Engng—Oct., 1910. Serial. 1st part. No. 17759 C.

MISCELLANY.

Analyses.

Report of Analyses of Ores, Non-Metallic Minerals, Fuels, Etc. Made in the Chemical Laboratories During the years 1906, 1907, 1908. Arranged by F. G. Wait. 2 plates. 20000 w. Can Dept of Mines—No. 59. No. 17981 N.

Asia Minor.

The Mineral Resources of Asia Minor. A résumé of the principal mineral deposits of Turkey in Asia. 2800 w. Min Jour—Oct. 15, 1910. No. 18161 A.

Canada.

The Mineral Industries of Canada. H. Mortimer-Lamb. Read before the Int. Congress at Dusseldorf. Reports recent progress of the mining industries, and presents a survey of conditions in the hope that the information will lead to a study of the mineral area. Ills. 22500 w. Sec. IV. Paper 15. No. 18217 N.

Ore Deposits.

Surface Indications of Ore-Shoots in Depth. William H. Storms. Gives facts from the writer's observation and experience concerning the topographical conditions which may be considered to indicate ore-shoots beneath the surface. 2500 w. Min & Sci Pr—Oct. 22, 1910. No. 18225.

The Agency of Manganese in the Superficial Alteration and Secondary Enrichment of Gold-Deposits in the United States. William H. Emmons. An ex-

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perimental study, with discussion of results, and review of mining districts. Map. 23000 w. Bul Am Inst of Min Engrs—Oct., 1910. No. 18131 F.

Philippines.

The Mineral Resources of the Philippine Islands, with a Statement of the Production of Commercial Mineral Products During the Year 1909. Papers by various writers giving information concerning the metallic and non-metallic ore deposits, the geology, and related subjects. Maps and illustrations. 26500 w. Philippine Bureau of Science—1910. No. 17836 N.

Refractory Materials.

Refractory Materials for Electric Furnaces (Widerstandsmaterial für elektrische Oefen). W. Schuen. A review of various materials used for lining electric furnaces. Ills. Serial. 1st part. 2000 w. Elektrochem Zeitschr—Sept., 1910. No. 18033 D.

Taxation.

System of Taxing Mining Properties in Colorado. A. G. Brownlee. Read before the Am. Min. Cong. A critical discussion of the existing law and its interpretations. 1500 w. Min Wld—Oct. 1, 1910. No. 17625.

RAILWAY ENGINEERING.

CONDUCTING TRANSPORTATION.

Accidents.

The Roscrea Collision. Gives conclusions of Col. von Donop's report on the collision in Ireland on July 19th. Also editorial. 5000 w. Engr, Lond—Sept. 23, 1910. No. 17683 A.

Signaling.

Railway Signaling. C. L. Hacket. Read before the Cent. Ry. & Engng. Club of Canada. Brief discussion of interlocking, block signals, and miscellaneous signals, and the principles on which they are based. 3500 w. Can Engr—Oct. 20, 1910. No. 17992.

Note on the Electric Treadles for Locking the Points on the Belgian State Railways. L. Weissenbruch and J. Verdeyen. Describes the appliances and explains the principles of working. Ills. 2800 w. Bul Int Ry Cong—Aug.-Sept.-Oct., 1910. No. 18178 G.

Signaling at the New Grand Central Terminal. Gives plans of the tracks on the upper and lower levels, plans and elevations of the principal signal cabin, and information about the arrangements for the interlocking. Ills. 2 insets. 2000 w. Ry Age Gaz—Oct. 7, 1910. No. 17744.

The New Hydraulic M. D. M. Signal Plant (System Aster) for the Interlocking of Points and Signals at the Paris-Nord Station (Nouvel Autocombinateur M. D. M., Système Aster, pour la Commande par Fluide et l'Enclenchement des Aiguilles et des Signaux mis en Service à la Gare de Paris-Nord). Paul Aumont. Detailed description. Ills. 7000 w. Rev Gen d Chemins de Fer—Sept., 1910. No. 18005 G.

MOTIVE POWER AND EQUIPMENT.

Air Brakes.

Brakes Sticking. Has particular reference to the No. 6 distributing valve with the quick action cap. 2500 w. Ry & Loc Engng—Oct., 1910. No. 17657 C.

Automatic Connectors for Freight and Passenger Train Cars. Willis C. Squire. An illustrated discussion of the subject of automatically connecting up the air brakes between cars, the types, location of connectors, locking devices, etc., with general discussion. 16000 w. Pro W Ry Club—Sept. 20, 1910. No. 17998 C.

Rapidity of Action of Vacuum and Pressure Brakes (Die Durchschlaggeschwindigkeit bei den Luftsauge- und Druckluftbremsen). Karl Kobes. A mathematical study based on the results of the Austrian tests. Ills. 16000 w. Zeitschr d Oest Ing u Arch Ver—Sept. 2, 1910. No. 18064 D.

Car Cleaning.

Unscientific Methods of Coach Cleaning. Wilbur F. Leach. Information concerning the injuries from the use of dopes, soaps, oxalic acid, and ill-advised methods. 1200 w. Ry Age Gaz—Oct. 7, 1910. No. 17746.

Electrification.

The Project for the Electrification of the Austrian State Railways (Bericht über die Vorarbeiten zur Elektrifizierung der K. K. Oesterreichischen Staatsbahnen). Artur Hruschka. A report of the preliminary studies. Ills. Serial. 1st part. 4000 w. Elek Kraft u Bahnen—Sept. 4, 1910. No. 18079 D.

Inauguration of Electric Traction on the Kiruna-Riksgränsen Line of the Swedish State Railways (Einführung des elektrischen Betriebes auf der schwedischen Staatsbahnstrecke Kiruna-Riksgränsen). J. Oefverholm. A brief description of the line and equipment. Ills. 2700 w. Elek Kraft u Bahnen—Sept. 4, 1910. No. 18080 D.

Freight Cars.

High-Capacity Self-Discharging Wagon. Illustrations with brief description of a double-bogie type built for an Italian lignite works. 200 w. Engng—Oct. 14, 1910. No. 18163 A.

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Quick-Dumping Drop-Bottom Steel Cars for Handling Iron Ore on the Michigan Iron Range. Illustrated description of two of the new types of cars, with explanation of the performance of the Summers ore car. 3000 w. Eng News—Oct. 27, 1910. No. 18193.

Locomotive Boilers.

The Power of a Locomotive Boiler. C. Hugh Sumner, in *Engng. Rev.* Traces the relation between the size of the boiler and the power developed by the locomotive. 2000 w. Boiler Maker—Oct., 1910. No. 17752.

Locomotive Design.

British Locomotive Development. R. H. Rogers. Discusses recent changes in locomotive design, the problems confronting the motive power departments, and the methods being employed to solve them. 3500 w. Am Engr & R R Jour—Oct., 1910. No. 17755 C.

Locomotive Injectors.

Repairing, Operating and Caring for Inspirators. M. H. Westbrook. Illustrated description of the Hancock inspirator, with suggestions for its repair. 1200 w. Mach (Ry Ed)—Oct., 1910. No. 17800 C.

Locomotive Performance.

Tests of the Latest P. L. M. Compounds with Four Coupled Axles and Pilot Truck (Essais effectivés avec les dernières Locomotives Compound à quatre Essieux couplés et à Bogie de la Compagnie P. L. M.). M. Vallantin. Gives details of the locomotives, the tests, and the results. Ills. 7500 w. Rev Gen d Chemins de Fer—Sept., 1910. No. 18006 G.

Locomotives.

Powerful Lignite Burner of the Mikado Type. Illustrated description of an engine for the Oregon R. R. & Nav. Co. 900 w. Am Engr & R R Jour—Oct., 1910. No. 17756 C.

Simple 2-8-2 for the Oregon Railroad Navigation Co. Illustrated description of a heavy Mikado type using lignite fuel. 900 w. Ry & Loc Engng—Oct., 1910. No. 17656 C.

Heavy Pacific Type Locomotives for the Vandalia R. R. Illustrated detailed description of new engines for heavy trains, with record of eight typical runs. 1200 w. Ry & Engng Rev—Oct. 1, 1910. No. 17686.

Pacific Type Locomotive; Central Railroad of Brazil. Illustrates and describes details of the engine and superheater. 500 w. Ry Age Gaz—Oct. 28, 1910. No. 18230.

Locomotive with Water Tube Fire Box. Illustrated description of an engine for the Northern Ry. of France. 700 w. Am Engr & R R Jour—Oct., 1910. No. 17757 C.

British Locomotives in 1909. J. F. Gairns. Illustrated review of their design and work. 9000 w. Bul Int Ry Cong—Aug.-Sept.-Oct., 1910. No. 18179 G.

French and Foreign Locomotives at the Brussels Exposition (Les Locomotives françaises et étrangères à l'Exposition de Bruxelles de 1910). L. Pierre-Guédon. An illustrated review of the exhibits. Serial. 1st part. 4000 w. Génie Civil—Sept. 3, 1910. No. 18017 D.

Locomotive Superheating.

Superheating on London and Northwestern Locomotives. Illustrated description of a design for two engines, the "George V" and "Queen Mary," exactly alike only one is fitted with Schmidt's system of superheating. They are to be tried on exactly similar work. 500 w. Engr, Lond—Oct. 7, 1910. No. 17913 A.

Locomotive Valve Gears.

Design and Graphical Investigation of the Heusinger Valve Gear for Locomotives (Berechnung und graphische Ermittelung der Heusinger-Steuerung für Lokomotiven). S. E. W. Westren-Doll. A detailed study of the gear. Ills. Serial. 1st part. 5300 w. Glasers Ann—Sept. 1, 1910. No. 18061 D.

Passenger Cars.

The Tait Suburban Car. Illustrates and describes cars for the Victorian government railways of Australia. 1000 w. Ry & Loc Engng—Oct., 1910. No. 17654 C.

Refrigeration.

The Chateau Renard Experimental Refrigeration Station (La Station experimentale du Froid de Chateau Renard). E. Lemaire. Describes a plant to investigate the conditions favorable to the transport of perishable freight. Ills. 2100 w. Génie Civil—Sept. 24, 1910. No. 18022 D.

Shops.

Shops of the National Transcontinental Ry. of Canada. Illustrates and describes the shops at St. Boniface, near Winnipeg. 6500 w. Ry Mas Mech—Oct., 1910. No. 17850.

Engine House Kinks. Illustrates and describes methods and devices used at various shops. 3500 w. Ry Age Gaz—Oct. 7, 1910. No. 17747.

Sleeping Cars.

All Steel Pullman Cars. Illustrated description of a design for all steel sleeping, parlor, club and private cars, which permits the use of a standard underframe complete and many other standard parts. The description given applies principally to the sleeping cars. 1500 w. Am Engr & R R Jour—Oct., 1910. No. 17754 C.

Testing Materials.

The Testing Department of a Railroad Company. B. S. Hinckley. Explains the aim of this department, giving some of the forms used to record the work, and explanation of the advantages. General discussion. 15000 w. Pro N Y R R Club—Sept. 16, 1910. No. 17927.

Analysis—Chemical and Otherwise. E. M. Tewkesbury. Briefly reviews the won-

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derful development of railways, discussing the need of chemical analysis and physical tests in solving problems relating to the materials used, and the present requirements of traffic. General discussion. 14500 w. Pro Cent Ry Club—Sept. 9, 1910. No. 17928 C.

Train Lighting.

The Leitner System of Electric Train Lighting (Système Leitner pour l'Eclairage électrique des Trains). H. Marchand. Detailed description of the apparatus. Ills. 2500 w. L'Elecn—Sept. 17, 1910. No. 18010 D.

Comparative Cost of Train Lighting by Gas and Electricity (Vergleichende Kostenrechnung für Zugbeleuchtung mit Gasglühlicht und Elektrizität). Max Jakob. Presents estimates of first and operating costs for the two systems. Ills. Serial. 1st part. 2400 w. Tech u Wirt—Sept., 1910. No. 18208 D.

NEW PROJECTS.

Germany.

The New Weisenbach-Forbach Line in the Black Forest (Eine neue Schwarzwaldbahn Weisenbach-Forbach). Herr Gaber. Describes a new mountain line in Germany which involved heavy construction work. Ills. Serial. 1st part. 1000 w. Deutsche Bau—Sept. 17, 1910. No. 18053 B.

Western Maryland.

Western Maryland's Trunk Line Extension. An illustrated description of 87 miles of new construction in progress through the Alleghenies, as a part of a new trunk line between the east and west. 6000 w. Mfrs' Rec—Oct. 27, 1910. No. 18180.

PERMANENT WAY AND BUILDINGS.

Ballast Loader.

Car-Traversing Ballast Loader. Illustrated description of a ballast loader designed by E. J. Beard while building the Philippine Rys. 1000 w. Ry Age Gaz—Oct. 21, 1910. No. 17968.

Curves.

How to Run in Transition Curves Without Tables. C. P. Howard. Explanatory notes. 1500 w. Eng News—Oct. 13, 1910. No. 17843.

Rails.

Rail Steel (Ueber Schienenstahl). Pierre Breuil. Abstract of a paper read at the Düsseldorf Congress, discussing American and European rail steel. Ills. 2500 w. Stahl u Eisen—Sept. 14, 1910. No. 18037 D.

Stations.

Report No. 2 on the Question of Large Stations for Russia, Austria, Hungary, Turkey, Roumania, Bulgaria and Servia. A. Kain. Considers arrangement of tracks, mechanical appliances, etc. Ills. 15700 w. Bul Int Ry Cong—Aug-Sept-Oct., 1910. No. 18177 G.

Terminals.

The New York Improvement and Tunnel Extension of the Pennsylvania Railroad. A finely illustrated description of this great engineering work and the terminal station. Plates. 2500 w. Am Archt—Oct. 5, 1910. No. 17699.

Opening of the Pennsylvania Railroad Station, New York. Illustrates and describes the distinctive features of the station, and gives information relating to the tunnels. 1500 w. Mach (Ry Ed)—Oct., 1910. No. 17799 C.

Terminal Conditions in Chicago. An explanation of conditions and the troubles due to them, with suggestions of the committee appointed to investigate the situation. 3500 w. Ry Age Gaz—Oct. 14, 1910. No. 17855.

Ties.

An Economic Comparison of Railway Ties of Different Materials. Neil N. Campbell. Shows methods of comparison and results obtained by their use. 2000 w. Eng News—Sept. 22, 1910. No. 17352.

Track Maintenance.

A Track Lifting and Ballasting Machine. A machine that does the work of jacks and shovelers is described and illustrated. 700 w. Sci Am—Oct. 8, 1910. No. 17722.

TRAFFIC.

Freight Rates.

Mr. McCrea on Railway Finances. Testimony before the Interstate Commerce Commission, Oct. 12, in regard to the necessity for rate advance. 2200 w. Ry Age Gaz—Oct. 21, 1910. No. 17967.

MISCELLANY.

Austria.

Transportation and Traffic in Austria-Hungary. Logan G. M'Pherson. Preliminary report to the Nat. Waterways Com. Reviews what has been done toward improving rivers, constructing canals, steam railways and their control. 3000 w. Ry Age Gaz—Oct. 28, 1910. No. 18231.

Capitalization.

Railway Capital and Capitalization. William Z. Ripley. Explains the use of their terms both in a commercial and economic sense, the value of railway securities, the distinction between gross and net capitalization, etc. 2500 w. Ry Age Gaz—Oct. 21, 1910. Serial. 1st part. No. 17966.

Great Britain.

British Railways: Some Facts and a Few Problems. Prof. W. E. Dalby. Presidential address before the Engng. Soc. of the British Assn. for the Adv. of Science. Presents facts and problems connected with recent developments of railway working. 3000 w. Mech Engr—Sept. 23, 1910. Serial. 1st part. No. 17670 A.

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Legislation.

The Mann-Elkins Act. Frank Haigh Dixon. Abstracted from *Qr. Jour. of Economics.* Discusses the provisions of this amended act of the U. S. Congress. 7000 w. Ry Age Gaz—Oct. 14, 1910. No. 17853.

The New Legislation on Secondary Railways in Austria (Das neue Gesetz über Bahnen niederer Ordnung). Gives the text of the act passed by the Reichsrat on Aug. 8, 1910. 6000 w. Mitt d Ver f d Förd d Lokal u Strassenbahnwesens—Sept., 1910. No. 18032 F.

New Zealand.

Interesting Railway Achievements in New Zealand. W. Wilson. Describes methods by which great natural difficulties have been overcome. Ills. 2000 w. Engineering Magazine—Nov., 1910. No. 18253 B.

Palestine.

The Railways of the Holy Land. Harold J. Shepstone. Illustrated description of the lines. 1800 w. Sci Am Sup—Oct. 15, 1910. No. 17846.

United States.

The Railway Owner, Railway Employee and Railway User. Howard Elliott. Extracts from an address at the Montana State Fair. Discusses the need of co-operation for the common benefit. 3000 w. Ry Age Gaz—Oct. 21, 1910. No. 17969.

Wales.

A New Railway in South Wales. Illustrates and describes interesting features and physical difficulties in the construction of the Treforest extension of the Cardiff railway. 2500 w. Engr, Lond—Oct. 14, 1910. No. 18172 A.

STREET AND ELECTRIC RAILWAYS.

Adhesion Railways.

The Bernina Railway (Die Berninabahn). F. Niethammer. Brief description of the Brusio power station, the substations, and the line, a part of which is on the adhesion system. Ills. Serial. 1st part. 3000 w. Elektrotech u Maschinenbau—Sept. 4, 1910. No. 18088 D.

Car Brake Shoes.

Comparative Durability of Brake Shoes and Tyres. J. W. Dawson. Read before the Munic. Tram. Assn. Describes investigations of the wearing effect upon steel tramway tires by brake shoes, stating conclusions. 4500 w. Elec Engr, Lond—Sept. 30, 1910. No. 17805 A.

Car Meters.

Some Practical Results of the Use of Car Meters. M. Battes. Abstract of a report on replies to questions sent out, with summary of progress made in the use of such meters. 3000 w. Elect'n, Lond—Sept. 30, 1910. No. 17824 A.

Results Obtained by the Use of Car Meters on Tramways. G. Bouton. Abstract of a report on the replies received by the Union Intnat. de Tram. et de Chem. de Fer, etc., in response to questions, with conclusions from a study of results. 4000 w. Elect'n, Lond—Oct 7, 1910. No. 17895 A.

Cars.

Single-Phase Interurban Car Equipments of the Rock Island & Southern Railroad. L. G. Riley. Illustrated description of the equipments for passenger cars, express and freight cars, method of motor drive, etc. 2500 w. Elec Jour—Oct., 1910. No. 17976.

Design of Cars for Chicago Street Railways. Information from the second annual report of the Board of Sup. Engrs. of Chicago Traction, about the design of new street cars. 2500 w. Elec Ry Jour—Oct. 29, 1910. No. 18233.

Car Wheels.

See Car Brake Shoes, under STREET AND ELECTRIC RAILWAYS.

Conductor Maintenance.

Brooklyn Line Department—Manufacturing Facilities, Purchasing Standards and Experimental Work. This sixth and concluding article of a series deals with line material manufacture, storage, purchasing and experimental work. Ills. 5000 w. Elec Ry Jour—Nov. 5, 1910. No. 18359.

Controllers.

Hand Operated Unit Switch Control. Karl A. Simmon. Illustrates and describes details of operation, electrical and mechanical details, and explains advantages claimed. 2500 w. Elec Jour—Oct., 1910. No. 17978.

Notes on the Maintenance of Electro-Pneumatic Control. Gives information based on experience. 2200 w. Elec Ry Jour—Nov. 5, 1910. No. 18362.

Elevated Yards.

Elevated Car Storage Yard. The new yard for subway cars under construction in New York City, extending north from West 240th St., is illustrated and described. 1800 w. Eng Rec—Oct. 15, 1910. No. 17868.

Freight Traffic.

Freight Service of the Scioto Valley Traction Company. Illustrated description of the organization, equipment, methods, development and results. 2000 w. Elec Ry Jour—Oct. 22, 1910. No. 17963.

Locomotives.

Mechanical Features of Electric Locomotives. G. M. Easton. A discussion of the desired characteristics, reliability, etc.,

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and a comparison of details with steam locomotives. 3000 w. Elec Jour—Oct., 1910. No. 17975.

The Parallel-Crank Drive for Electric Locomotives (Das Parallelkurbelgetriebe als Antriebsmittel für elektrische Lokomotiven). Herr Kleinow. A mathematical and kinematic study of the drive. Ills. 2500 w. Elek Kraft u Bahnen—Sept. 4, 1910. No. 18081 D.

Netherlands.

The Utrecht-De Bilt-Zeist Electric Railway (De electrische tramweg Utrecht-De Bilt-Zeist). E. C. W. van Dijk. Brief description of this interurban line in the Netherlands and its equipment. Ills. 4500 w. De Ingenieur—Sept. 3, 1910. No. 18209 D.

New York City.

Rehabilitation of the Second Avenue Railroad, New York. Brief outline of the history of this independent line, with illustrated description of repairs to tracks and equipment, power supply, etc., to maintain efficient service and reduce cost of operation. 2500 w. Elec Ry Jour—Oct. 29, 1910. No. 18232.

Rack Railways.

Mountain Rack Railways and the Jungfrau Ry. (Switzerland). E. L. Corthell. Gives a table showing railway built on the Abt rack-rail system, with details, and describing important changes and progress on the Jungfrau Ry. Ills. 2000 w. Eng News—Oct. 27, 1910. No. 18195.

Railless.

Trackless Electric Roads. A. Heller. Trans. from *Zeit. des Ver. Deut. Eng.* Illustrated review of the present state of the art. 1800 w. Sci Am Sup—Oct. 29, 1910. No. 18237.

Single Phase.

What Frequency Should be Employed for Single-Phase Traction with Regard to the Present and Future Development of the Single-Phase Motor (Welche Periodenzahl sollte mit Rücksicht auf der gegenwärtigen und künftigen Stand der Triebmotorentechnik bei Einphasenwechselstrombahnen Anwendung finden)? Wilhelm Wittek. Advocates further study before abandoning twenty-five cycles. 6000 w. Elektrotech u Maschinenbau—Sept. 18, 1910. No. 18092 D.

Subways.

Construction of a Rapid Transit Railroad in Relation to the Handling of Passengers, as Illustrated by the Hudson and Manhattan Railroad. J. Vipond Davies. States the problems of passenger transportation due to concentration in cities, and describes the solution as adopted by the company named. 8500 w. Pro Engrs' Club of Phila, No. 1091—Oct., 1910. No. 18249 D.

The Letting of Contracts for the Tri-Borough Rapid Transit R. R. in New York City. Editorial on rapid transit underground railway construction in New York City, with record of bids for the construction of the Tri-Borough Ry. 10000 w. Eng News—Nov. 3, 1910. No. 18354.

Motor Trains on Long Island Road. W. B. Kouwenhoven. Describes the car service through the Pennsylvania tunnels under the East River. 2500 w. Ry & Loc Engng—Nov., 1910. No. 18320 C.

Terminals.

Urban and Interurban Terminals. Martin Schreiber and F. F. Low. Abstract of paper forming a part of the report of the committee of buildings and structures of the Am. St. & Int. Ry. Engng. Assn. Ills. 2000 w. Elec Ry Jour—Oct. 15, 1910. No. 17881.

Three-Phase.

Three-Phase Traction in Italy. Warren H. Miller. Illustrated account of practical problems encountered on the three-phase Giovi line. 1800 w. Elec Wld—Oct. 13, 1910. No. 17857.

Ties.

Chemical Treatment of Ties Used in the Chicago Track Rehabilitation. Abstract from report of the Board of Sup. Engrs. of Chicago Traction, on investigations made preliminary to the adoption of the chloride of zinc treatment. 1500 w. Elec Ry Jour—Oct. 29, 1910. No. 18234.

Track Construction.

The Track and Line Construction of Electric Railways. Gives tabulated results of an inquiry as to general practice in track construction, pole and line equipment of interurban electric lines, with a review of the information. 7000 w. Eng News—Oct. 27, 1910. No. 18199.

Track Reconstruction on the Chicago Street Railways. Illustrates and describes types of track, and methods of construction, material, foundation, paving, etc. 7500 w. Eng News—Nov. 3, 1910. No. 18349.

Traffic.

Advertising Methods and Traffic of the Cleveland, Painesville, and Eastern Railroad. E. L. Schmock. An account of methods used on this Ohio line. 2000 w. Elec Ry Jour—Nov. 5, 1910. No. 18360.

Trolley Lines.

Itemized Unit Costs of 98 Special Overhead Layouts for a Trolley Railway. Diagrams. 6000 w. Engng-Con—Oct. 19, 1910. No. 17950.

See Track Construction, under STREET AND ELECTRIC RAILWAYS.

Winnipeg.

Construction and Operating Features of the Winnipeg Electric Railway. Illustrated detailed description of the Winnipeg system and its operation. 4000 w. Elec Ry Jour—July 9, 1910. No. 15421.

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EXPLANATORY NOTE—THE ENGINEERING INDEX

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THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Anales de la Soc. Cien. Argentina. *m.* Buenos Aires.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. Ing. d Arch Ital. *s-m.* Rome.
Architect. *w.* London.
Architectural Record. *m.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Melbourne.
Autocar. *w.* Coventry, England.
Automobile. *w.* New York.
Automotor Journal. *w.* London.
Beton und Eisen. *qr.* Vienna.
Boiler Maker. *m.* New York.
Brass World. *m.* Bridgeport, Conn.
Brickbuilder. *m.* Boston.
Builder. *w.* London.
Bull. Bur. of Standards. *qr.* Washington.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. of Can. Min. Inst. *qr.* Montreal.
Bull. Soc. Int. d'Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
Bull. Scien. de l'Assn. des Elèves des Ecoles Spéc. *m.* Liége.
Bull. Tech. de la Suisse Romande. *s-m.* Lausanne.
California Jour. of Tech. *m.* Berkeley, Cal.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *w.* Toronto and Montreal.
Canadian Mining Journal. *b-w.* Toronto.
Cassier's Magazine. *m.* New York and London.
Castings. *m.* Cleveland, O.
Cement. *m.* New York.
Cement Age. *m.* New York.
Central Station. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Commercial Vehicle. *m.* New York.

Compressed Air. *m.* New York.
Comptes Rendus de l' Acad. des Sciences. *w.* Paris.
Cornell Civil Engineer. *m.* Ithaca.
Deutsche Bauzeitung. *b-w.* Berlin.
Die Turbine. *s-m.* Berlin.
Domestic Engineering. *w.* Chicago.
Economic Geology. *m.* New Haven, Conn.
Electrical Age. *m.* New York.
Electrical Engineer. *m.* London.
Electrical Engineering. *w.* London.
Elec. Review and W. Elec'n. *w.* Chicago.
Electrical Review. *w.* London.
Electric Journal. *m.* Pittsburg, Pa.
Electric Railway Journal. *w.* New York.
Electrical World. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Elektrische Kraftbetriebe u Bahnen. *w.* Munich.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnik u Maschinenbau. *w.* Vienna.
Elektrotechnische Rundschau. *w.* Potsdam.
Elettricità. *w.* Milan.
Engineer. *w.* London.
Engineering. *w.* London.
Engineering-Contracting. *w.* New York.
Engineering Magazine. *m.* New York and London.
Engineering and Mining Journal. *w.* New York.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penna. *m.* Pittsburg, U. S. A.
Foundry. *m.* Cleveland, U. S. A.
Génie Civil. *w.* Paris.
Giesserei-Zeitung. *s-m.* Berlin.
Glasers Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Heating and Ventilating Mag. *m.* New York.
Horseless Age. *w.* New York.
Ice and Cold Storage. *m.* London.
Ice and Refrigeration. *m.* New York.
Il Cemento. *s-m.* Milan.
Industrial World. *w.* Pittsburg.
Ingegneria Ferroviaria. *s-m.* Rome.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Int. Marine Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. of Accountancy. *m.* N. Y.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal Franklin Institute. *m.* Philadelphia.
Jour. N. E. Water Works Assn. *qr.* Boston.
Journal Royal Inst. of Brit. Arch. *s-q.* London.
Jour. Roy. United Service Inst. *m.* London.
Journal of Sanitary Institute. *qr.* London.
Jour. of South African Assn. of Engineers. *m.* Johannesburg, S. A.
Journal of the Society of Arts. *w.* London.
Jour. Transvaal Inst. of Mech. Engrs., Johannesburg, S. A.
Jour. of U. S. Artillery. *b-m.* Fort Monroe, U. S. A
Jour. W. of Scot. Iron & Steel Inst. *m.* Glasgow.
Journal Western Soc. of Eng. *b-m.* Chicago.
Jour. of Worcester Poly. Inst., Worcester, U. S. A.
Locomotive. *m.* Hartford, U. S. A.
Machinery. *m.* New York.
Manufacturer's Record. *w.* Baltimore.
Marine Review. *m.* Cleveland, U. S. A.
Mechanical Engineer. *w.* London.
Mechanical World. *w.* Manchester.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Metallurgical and Chem. Engng. *m.* New York.
Métallurgie. *w.* Paris.
Metal Worker. *w.* New York.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco.
Mining Journal. *w.* London.
Mining Magazine. *m.* London.
Mining World. *w.* Chicago.
Mittheilungen des Vereins für die Förderung des Local- und Strassenbahnwesens. *m.* Vienna.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *w.* New York.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Oest. Wochensch. f. d. Oeff. Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg- & Hüttenwesen. *w.* Vienna.
Plumber and Decorator. *m.* London.
Power and The Engineer. *w.* New York.
Practical Engineer. *w.* London.
Pro. Am. Ins. Electrical Eng. *m.* New York.
Pro. Am. Ins. of Mining Eng. *m.* New York.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Pro. Am. Soc. Mech. Engineers. *m.* New York.
Pro. Canadian Soc. Civ. Engrs. *m.* Montreal.
Proceedings Engineers' Club. *qr.* Philadelphia.
Pro. Engrs. Soc. of Western Pennsylvania. *m.* Pittsburg.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Pro. U. S. Naval Inst. *qr.* Annapolis, Md.
Progressive Age. *s-m.* New York.
Public Works. *qr.* London.
Quarry. *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railway Age Gazette. *m.* New York.
Railway and Engineering Review. *w.* Chicago.
Railway and Loc. Engng. *m.* New York.
Railway Master Mechanic. *m.* Chicago.
Revue d'Electrochimie et d'Electrométallurgie. *m.* Paris.
Revue de Mécanique. *m.* Paris.
Revue de Métallurgie. *m.* Paris.
Revue Gén. des Chemins de Fer. *m.* Paris.
Revue Gén. des Sciences. *w.* Paris.
Revue Industrielle. *w.* Paris.
Rivista Marittima. *m.* Rome.
Rudder. *m.* New York.
Schiffbau. *s-m.* Berlin.
School of Mines Quarterly. *q.* New York.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Sibley Jour. of Mech. Eng. *m.* Ithaca, N. Y.
Signal Engineer. *m.* Chicago.
Soc. Belge des Elect'ns. *m.* Brussels.
Stahl und Eisen. *w.* Düsseldorf.
Stevens Institute Indicator. *qr.* Hoboken, U. S. A.
Surveyor. *w.* London.
Technik und Wirtschaft. *m.* Berlin.
Technique Moderne. *m.* Paris.
Tramway & Railway World. *m.* London.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Wood Craft. *m.* Cleveland, U. S. A.
Yale Scientific Monthly. *m.* New Haven.
Zeitschr. f. d. Gesamte Turbinenwesen. *w.* Munich.
Zeitschr. d. Mitteleurop. Motorwagen. Ver. *s-m.* Berlin.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschr. f. Werkzeugmaschinen. *b-w.* Berlin.